Devoted to
TEXTILE
CHEMISTRY
BLEACHING
DYEING
PRINTING
FINISHING

MAY 5, 1947
VOLUME 36, No. 9

AMERICAN DYESTUFF REPORTER

for good *Wines*

Fast "Wines" are as rare as good vintages, but when the shade of Wine bears the name *Solophenyl* you've got a "1929 Vintage."

Solophenyl Bordeaux 2 B L like all Solophenyl* colors is outstanding in its fastness to light — rating "7" — moreover it offers better than average wash fastness.

True Wine in shade with unusual "pile-up" value, it makes an excellent self-shade or shading element on cotton or viscose fabrics — and then . . .

Having little affinity for wool, it finds important use in the dyeing of unions where the extreme in light fastness is required — such fabrics as are intended for the automobile or upholstery trades.

Write Geigy for Leaflet 65 M.

*Registered U. S. Patent Office.

GEIGY COMPANY, INC.

89-91 BARCLAY STREET — NEW YORK—NEW YORK

Boston · Providence
Philadelphia · Charlotte
Chicago · Portland, Ore.
Toronto

Geigy
Dyestuff Makers Since 1850

In Great Britain
The Geigy Co., Ltd.
National Buildings
Parsonage, Manchester

OFFICIAL PUBLICATION
of the
PROCEEDINGS
AMERICAN ASSOCIATION
OF TEXTILE CHEMISTS
AND COLORISTS

YES!
YOU CAN MEET
THE DEMAND FOR

IMPROVED

STAIN RESISTANCE

WATER REPELLENCE

WITH

PARAMUL 115

A Cyanamid Textile Finish for

COTTON
RAYON
LINEN
WOOLENS

PARAMUL** 115 Water Repellent is an aqueous solution of wax and aluminum salts that imparts superior water repellency and stain resistance to a wide variety of fabrics—cotton, rayon, linen and wool. It is equally suitable for treating such fabrics for outerwear or equipment purposes. Easy and economical to use. Odorless and harmless to skin or fabric. Stable over a wide range of temperatures, it can be stored safely for long periods of time. In its ability to meet a specific need precisely, PARAMUL 115 is typical of the many Cyanamid products developed for use in the textile industry.

CALL CYANAMID! The services of Cyanamid's technical service staff backed by our extensive textile research facilities are ready to assist you to achieve superior results . . . *economically* . . . in water repellence and stain resistance for your fabrics.

Industrial Chemicals Division

AMERICAN CYANAMID COMPANY

30 ROCKEFELLER PLAZA • NEW YORK 20, N. Y.

AMONG CYANAMID PRODUCTS FOR THE TEXTILE INDUSTRY ARE... Penetrants, Softeners, Finishes, Sizing Compounds, DECERESOL* Wetting Agents, PARAMUL115 Water Repellent, and other Specialties and Heavy Chemicals. For low-cost chemical equivalent of distilled H_2O...FILT-R-STIL* Demineralizing Units.**

***Reg. U. S. Pat. Off. **Trade-mark**

American Dyestuff Reporter, Vol. 36, No. 9, May 5, 1947. Published every other Monday.

Copyright, 1947, by Howes Publishing Co., One Madison Ave., New York 10, N. Y.

Domestic subscription, $5.00; Canadian, $6.00; Foreign, $6.00. Entered as second-class matter, Nov. 6, 1919, at the New York, N. Y., Post Office, under the act of March 3, 1879.

Ciba DYESTUFF GLIMPSES

In all science there is nothing more fascinating than the production of color from the sticky black substance we call coal tar. Many and various, however, are the steps that lead to the present day dyestuffs which help create our modern way of life by making clothing more cheerful, women more beautiful and life itself more enjoyable.

First comes the careful distillation of the coal tar to produce products like benzene, toluene and naphthalene. These are basic materials but Ciba has always recognized the fact that only the purest parent substances can give birth to dyestuffs of Ciba's standard. A good start is essential! As a result, these products and others developed by further processing are tested for purity again and again — as for instance, by determining the melting point.

For this purpose a little glass flask is necessary, fitted with a thermometer and a stirring appliance and heated by a small gas jet. The tiny glass tubes containing the substance under test are hung in the flask, dipping into the sulphuric acid or molten paraffin wax with which it is filled.

Let us suppose that a sample of naphthalene is being examined. If it melts at 80° C. exactly, the chemist is satisfied, for the naphthalene is pure. Should it melt at 77° C., however, it is impure and must be purified further. Every pure substance has a definite, known melting point. While naphthalene melts at 80° C., anthracene, for example, must not melt below 217° C.

DYESTUFFS • CHEMICALS • INTERMEDIATES

CIBA COMPANY, INC.

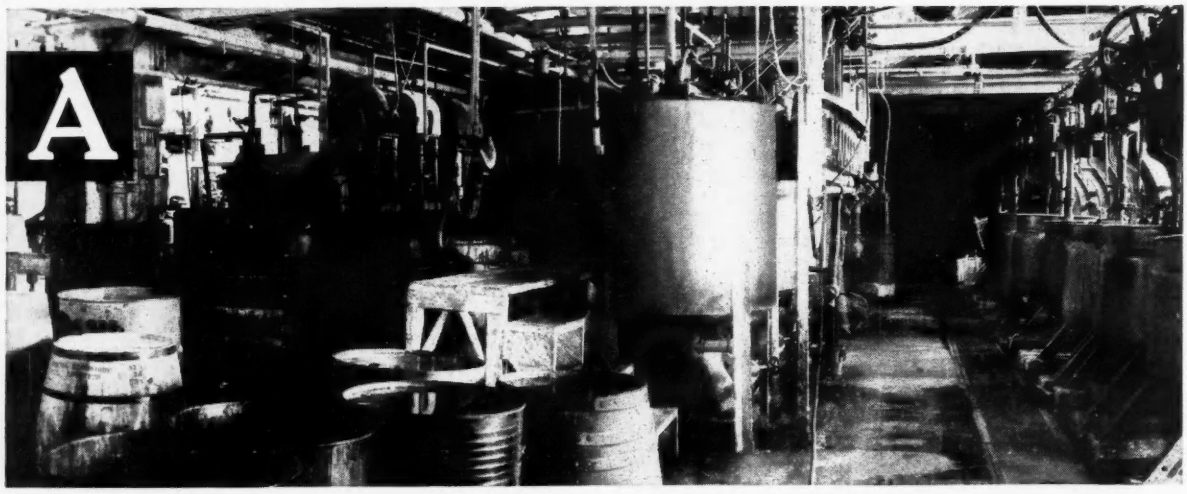
Greenwich & Morton Sts.

NEW YORK

BOSTON · CHICAGO · MONTREAL · CHARLOTTE
PROVIDENCE · SAN FRANCISCO · PHILADELPHIA

VAT DYES OF THE DOW CHEMICAL COMPANY

NEOLANS ON WOOL MEAN QUALITY RESULTS
with MINIMUM EFFORT



Which starch paste system saves money?

WE take you behind the scenes at a progressive textile printing plant.

Picture "A" shows the open-kettle system formerly used for cooking and cooling starch paste. Picture "B" shows what happened after conversion to continuous, closed cooking and cooling with VOTATOR industrial starch processing apparatus. No clutter. No encrustation of starch on equipment. No slimy deposit on the floor.

The VOTATOR equipped system is beautifully clean and correspondingly economical. It saves some $3,000.00 in processing cost per 275,000 gallons of starch paste, average monthly requirement at this plant.

There is no waste. Two men handle the job instead of five, in half the former floor space. Cooking and cooling takes place under cover, under mechanical control—and 10% less starch produces starch paste of uniform, fine-textured quality.

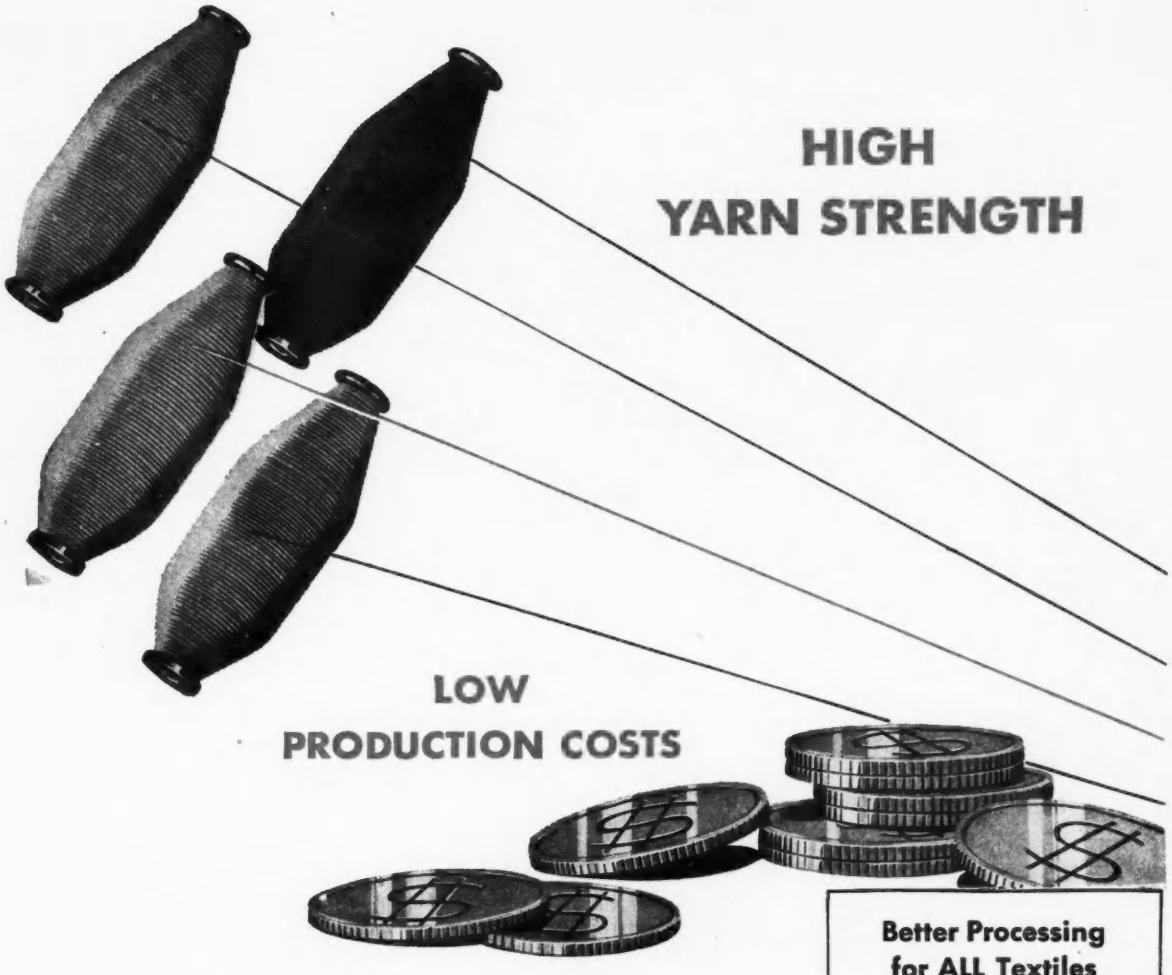
For further case history facts, write to the Girdler Corporation, Votator Division, Louisville 1, Kentucky.

DISTRICT OFFICES

150 Broadway, New York City 7 • 2612 Russ Bldg., San Francisco 4 • 617 Johnston Bldg., Charlotte 2, N. C.

Votator INDUSTRIAL STARCH PROCESSING APPARATUS

VOTATOR is a trade mark (Reg. U. S. Pat. Off.) applying only to products of The Girdler Corporation.



HIGH YARN STRENGTH

LOW PRODUCTION COSTS

S/V WOOLREX OILS give long card runs, reduce "ends down," scour out easily

FROM CARDING through to the final scouring, you get important advantages when you lubricate your wool stock with S/V Woolrex Oils.

These famous oils are outstanding for their rapid penetration and spreading qualities. This means uniformly conditioned and lubricated stock, minimum fiber breakage in carding, longer fibers and increased yarn strength. Freedom from gum-forming tendencies assures long card runs before stripping. High yarn strength means less "ends down" in spinning. All these mean savings in production costs.

Finally, with the correct grade of S/V Woolrex Oil on your stock, you can scour your cloth with minimum amounts of soap. No special detergents are required. The amount of soap normally used in fulling is sufficient to insure satisfactory scouring.

You'll find that S/V Woolrex Oils mean greater savings, increased production all along the line—factors that add up to increased profits. Get details from your Socony-Vacuum Representative.

SOCONY-VACUUM OIL CO., INC., 26 B'way, New York 4, N. Y., and Affiliates: Magnolia Petroleum Co., General Petroleum Corp.

Better Processing for ALL Textiles

Woolens . . . S/V Woolrex Oils improve carding and spinning. Scour out easily.

Worsteds . . . S/V Worstex Oils lubricate stock uniformly. Improve spinning.

Water Repellents . . . S/V Products give maximum repellency with minimum amounts.

Finishing . . . S/V Finishing Oils give excellent wetting, re-wetting and softening effects.

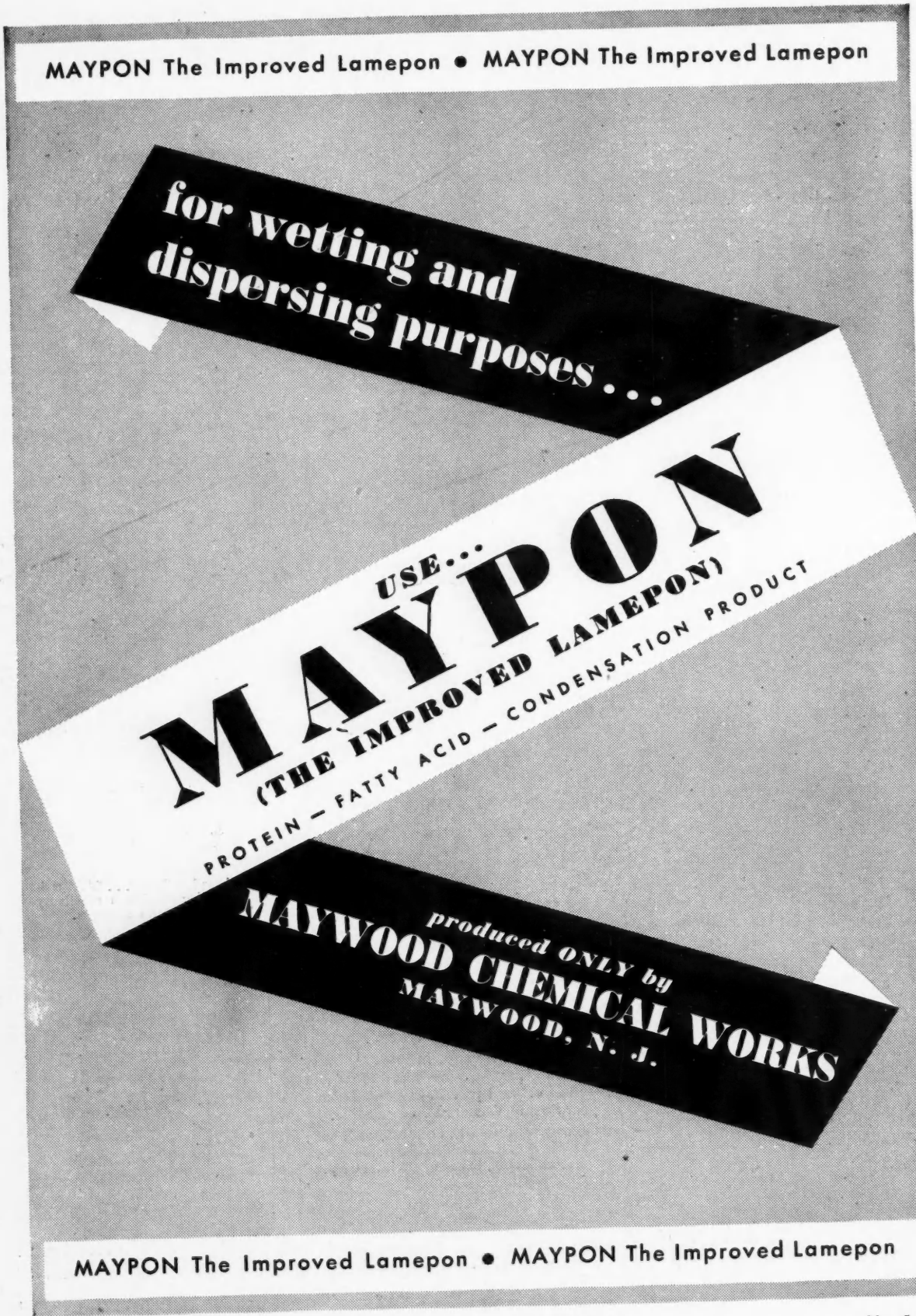
Shrinkage Process . . . S/V Finishing Oils insure quick, uniform re-wetting.

Rayon Processing . . . S/V Rayon Oils add softness to rayon fibers.

Process Products
SOCONY VACUUM

Socony-Vacuum Process Products

TUNE IN THE MOBILGAS PROGRAM — MONDAY EVENINGS, 9:30 E.D.T. — NBC


MAYPON The Improved Lamepon • MAYPON The Improved Lamepon
for wetting and dispersing purposes . . .
USE . . .
MAYPON
(THE IMPROVED LAMEPON)
PROTEIN — FATTY ACID — CONDENSATION PRODUCT
produced ONLY by
MAYWOOD CHEMICAL WORKS
MAYWOOD, N. J.
MAYPON The Improved Lamepon • MAYPON The Improved Lamepon

OUT OF THE FRYING PAN...

into high-grade soap!

LOW-GRADE KITCHEN FATS are now being used to make high-grade soaps! It's another interesting application of the powerful oxidizing action of chlorine dioxide.

The key to the commercial usage of chlorine dioxide is Mathieson's sodium chlorite ($NaClO_2$). This stable chemical permits *controlled* production of chlorine dioxide by industry . . . by the soap industry for the upgrading of inferior fats and oils . . . by the paper industry for the bleaching of kraft, sulfite, soda, rag and flax pulp to high brightness with minimum loss of fiber strength . . . by the water works field for the removal of unpleasant tastes and odors. In the textile industry, sodium chlorite itself provides the safe bleaching of cottons and rayons to *extra* whiteness.

It will pay you to investigate the many industrial applications of this unique oxidizing agent. Write to The Mathieson Alkali Works (Inc.), 60 East 42nd Street, New York 17, N. Y.

Mathieson
CHEMICALS
CAUSTIC SODA . . . SODA ASH . . . BICARBONATE OF SODA . . . LIQUID CHLORINE . . . CHLORINE DIOXIDE . . . AMMONIA, ANHYDROUS & AQUA . . . HTH PRODUCTS . . . FUSED ALKALI PRODUCTS . . . DRY ICE . . . CARBONIC GAS . . . SODIUM CHLORITE PRODUCTS . . . SODIUM METHYLATE

For Uniform Results In Textile Wet Processing . . . Use Hooker Chemicals

Whatever the textiles with which you are working —cottons, woolens or synthetics—there are Hooker Chemicals that will make your work easier, and help you maintain high standards of quality.

That's because Hooker, too, maintains high standards of purity and uniformity in the chemicals it manufactures. Your bleaching, dyeing and finishing processes can be smooth and trouble-free, and your results consistently uniform when you use Hooker Chemicals.

Continued improvements in manufacturing processes and equipment, careful supervision and control, strictly maintained specifications of purity are tenets of Hooker operations. All these combine to bring you chemicals that make standardizing of your operations practical.

Some of the Hooker Dyestuff and Textile Chemicals and the principal Hooker specifications are listed below. More complete information and samples will be furnished when requested on your business letterhead.

Hooker Products List, Bulletin 100, contains chemical and physical characteristics, uses and shipping information on nearly 100 Hooker Chemicals, many of them for the textile and dye industries. Send for a copy.

PRODUCT *Chemical Formula; Molecular Weight*	HOOKER SPECIFICATIONS	SUGGESTED USES
Antimony Trichloride Anhydrous $SbCl_3$; 288.1	Antimony Trichloride..... 99% Min. Iron and Arsenic..... 1% Max. Lead..... 0%	Catalyst in organic synthesis; mordant in textile printing. Moisture and fireproofing textiles.
Benzal Chloride $C_6H_5CHCl_2$; 161.0	Clear, yellow liquid. Boiling Range..... 200 to 235°C Specific Gravity 15.5°/15.5°C..... 1.279± .005	Dyestuff intermediate.
Chloranisidine $NH_2C_6H_3ClOCH_3$; 157.5	Gray crystalline solid. Melting Point..... 79°C Min. Diazo Test..... Relatively clear.	Dyestuff intermediate.
Lauryl Pyridinium Chloride C_5H_5N ($C_{12.6}H_{26.2}$)Cl; 292.0	Mottled tan, semi-solid. Solubility in water is 60 gms. per 100 gms. of water. Alkyl Pyridinium Chloride (Calc. as C_{12}) ..... 85.0% Min.	Cationic detergent. Wetting and cleaning agent for textile fibers. As a leveling agent and color modifier in dyeing.
Monochlorbenzene C_6H_5Cl; 112.5	Clear, colorless liquid. Distillation Range..... 131.3 to 132.3°C	Dyestuff intermediate, preparation of sulfur black, brown dyes. Solvent.
Orthodichlorbenzene, Tech. $C_6H_4Cl_2$; 147	Clear, colorless liquid. Freezing Point..... −10° to −22°C Boiling Range..... 6° including 179°C	Manufacture of pyrocatechin, dye intermediates, other synthetic organic chemicals. Degreasing wool.
Phosgene (Carbonyl Chloride) $COCl_2$; 98.9	Colorless gas at ordinary temperatures. Does not discolor a 0.2% solution of KI when vigorously bubbled through it for one half hour. (Test for free chlorine)	Dye intermediate; chlorinating agent.
Sodium Sulfhydrate NaSH; 56.1	NaSH..... 70 to 72% Na_2S..... .25 to 2.5% Fe..... 5 ppm Max. NaCl..... .4 to .8% Na_2SO_3, and $NaHCO_3$..... .04 to .4% Cu, Ni, Cr, Mn, Pb..... 1 ppm Max. Water of crystallization..... 28 to 26%	Desulfurizing rayon; calico printing; in sulfur dye baths.
Sodium Sulfide Na_2S; 78.1	Na_2S..... 60 to 62% Fe..... 8 ppm Max. NaCl..... 1.5% Max. Other Na Salts..... 2.0% Max. Cu, Ni, Cr, Mn, Pb..... 1 ppm Max. Water of crystallization..... 36.5 to 34.5%	Desulfurizing rayon; calico printing; in sulfur dye baths.

HOOKER ELECTROCHEMICAL COMPANY

HOOKER CHEMICALS

2 FORTY-SEVENTH ST., NIAGARA FALLS, N.Y.
New York, N.Y. Wilmington, Calif. Tacoma, Wash.

Caustic Soda **Chlorine** **Muriatic Acid** **Paradichlorbenzene** 2424

What a product!

All we ask you to do is to test this new detergent against any other on the market for stability in hard water, wetting-out dispersing, foaming, etc. and then you will see performance that will make you say "what a Product."

*REG. U. S. PAT. OFF.

Repcol is the most efficient product on the market — yet it costs you less.

REFINED PRODUCTS CORPORATION
Lyndhurst • New Jersey

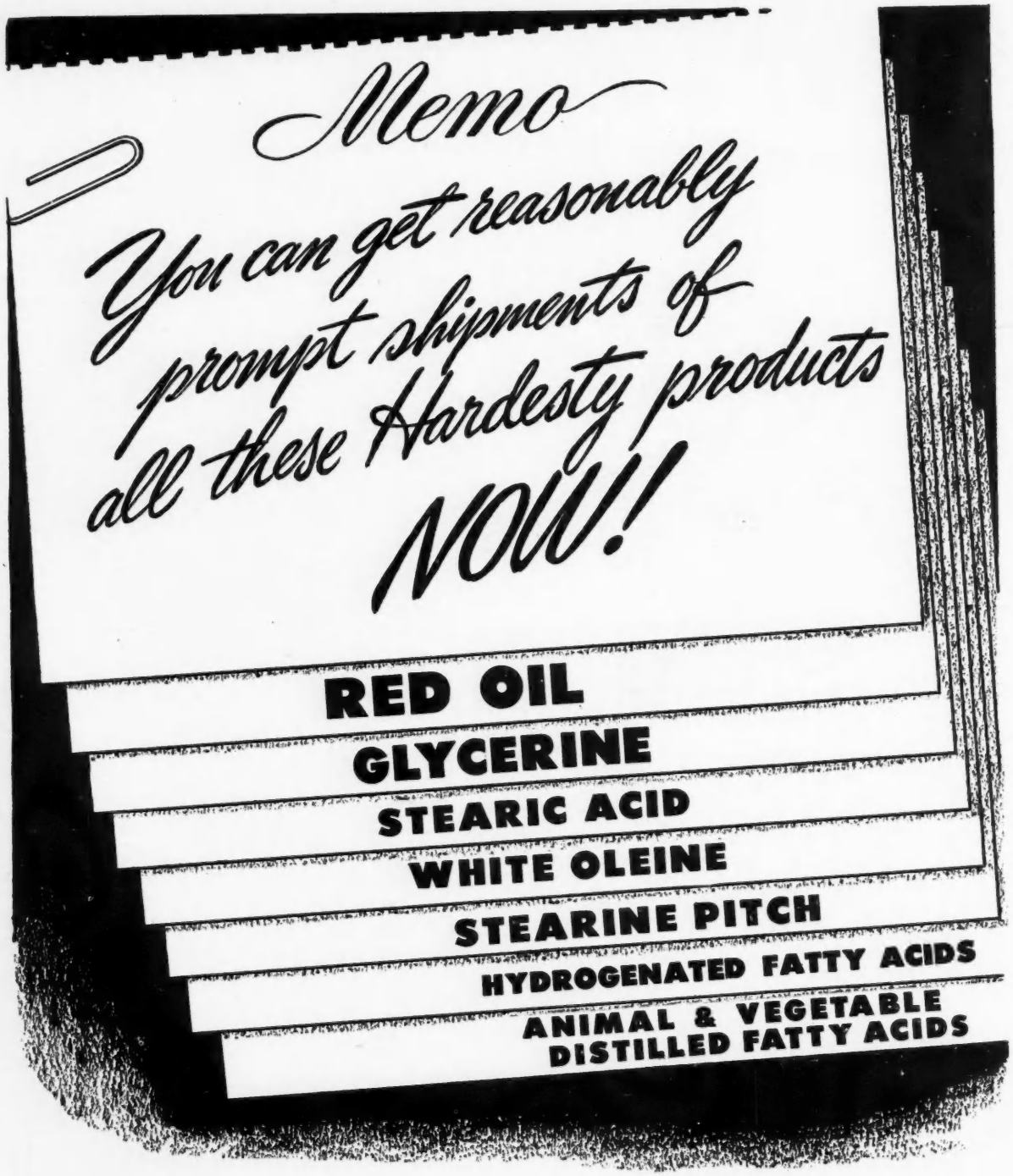
• Manufacturers of PERMA-CIDE, the approved, outstanding, mildew-proofing agent

Southern Representative: DYER S. MOSS, 1301 Liberty Life Bldg., Charlotte, North Carolina

New England Representatives: E. L. LEGG, P. O. Box 597, Providence, R. I.
CLARENCE E. MOSS, 19 Wilson Ave., Rumford (16) R. I.

Canadian Selling Agents: Berkeley Products Canada, Ltd., 41 Hillcrest Avenue, St. Catharines, Ontario, Canada

Exporting Agent: Chem-Cal Company, 82 Wall St., New York City



W. C. HARDESTY COMPANY, 41 East 42nd Street, New York 17, N. Y. FACTORIES: Dover, Ohio — Los Angeles, California — Toronto, Canada.

W·C·
HARDESTY
COMPANY

Here's important news for RESLOOM-ed wool

How does Resloom behave in cleaning operations? . . . how long does it last? These questions are always asked about a new textile chemical . . . and the National Institute of Cleaning and Dyeing has answered them in respect to Resloom in an official bulletin, stating, in brief:

1. WET CLEANING

Resloom treated wool will be easier to handle in the wet cleaning department than ordinary wool. Wet cleaning procedures ordinarily used in dry cleaning plants should cause no shrinkage whatever.

2. DRY CLEANING

Continued dry cleaning in either petroleum solvents or synthetic solvents (or continued wet cleanings) will not remove the finish.

3. SPOT CLEANING

Spotters will have no particular problems in stain removal. In general stains are more easily removed from Resloom treated wool than from ordinary wool.*

*From "Bulletin Service," Nov. 19, 1946, National Institute of Cleaning and Dyeing, Silver Spring, Md., George P. Fulton, Research Director.

A reprint of this complete bulletin, prepared by this independent laboratory, plus other information on Resloom, may be had by writing direct to: MONSANTO CHEMICAL COMPANY, Textile Chemicals Department, 140 Federal Street, Boston 10, Mass.

Resloom: Reg. U. S. Pat. Off.

MONSANTO CHEMICALS — PLASTICS

SERVING INDUSTRY . . . WHICH SERVES MANKIND

The Detergent that detours trouble

ORATOL L-48

● No guessing when you use Oratol L-48! This sulphonated amide is a powerful detergent with great foaming, emulsifying and wetting properties—gives equally successful results with cotton, wool, silk, rayon, acetates and aralac fibres!

Oratol L-48 is stable in hard water, under acid or alkaline conditions. Its use prevents the formation of insoluble soaps on the surface of dye liquors, and it acts as a dispersing agent for lime soap deposits. As a detergent and scour, in bleaching, dyeing and finishing, Oratol L-48 is outstanding! Priced low, this highly efficient product is well worth your attention. Samples and information on request.

WOLF BRAND PRODUCTS

JACQUES WOLF & CO.
Chemicals PASSAIC, N. J.

OTHER PLANTS: CARLSTADT, N. J. • LOS ANGELES, CALIF.
WAREHOUSES: Providence, R. I., Philadelphia, Pa., Utica, N. Y., Chicago, Ill., Greenville, S. C., Chattanooga, Knoxville, Tenn.

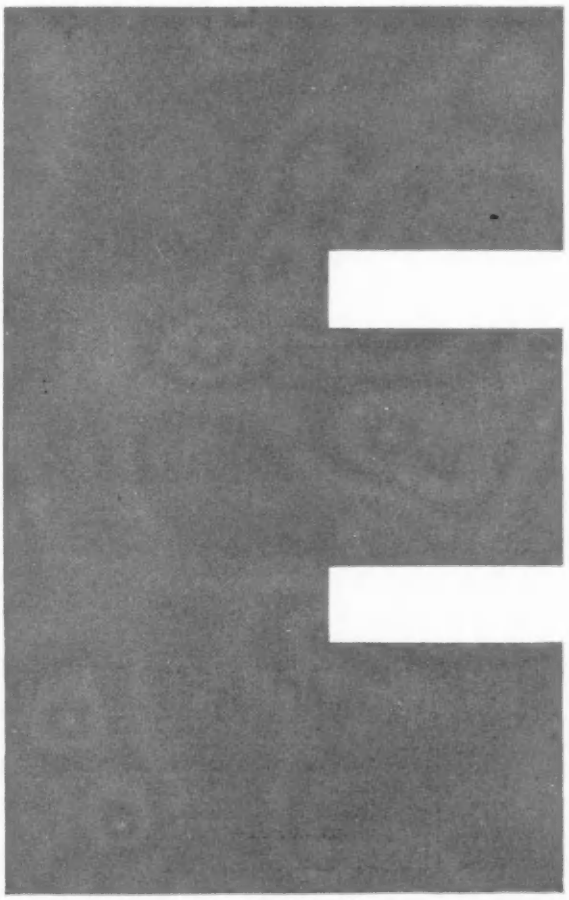
EASTONE ORANGE 2R CONCENTRATED

For Plain or Dischargeable Dyeing of Acetate Rayon and Nylon

EASTONE ORANGE 2R CONCENTRATED produces bright yellow-orange shades on acetate rayon fibers and somewhat redder shades on nylon. In application printing, it is used to print acetate or nylon fabrics bright golden orange.

Generally used as a base in compounding browns, tans, grays, and other shades, Orange 2R Concentrated has good resistance to gas fading, sublimation, washing, and crocking. Solubility is excellent, and the dye levels well over a range of 160° F to the boil. It is recommended for pastel grays and tans and also as a shading component of other light mode shades which can be discharged by the Eastone process.

Eastone Orange 2R Concentrated is one of a wide variety of Eastman Acetate Dyestuffs especially developed for acetate rayon fibers. For more information, write TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Company), KINGSPORT, TENNESSEE.



Eastman

ACETATE DYESTUFFS

ter, under
s use pre-
e soaps on
t acts as a
deposits.
bleaching,
ratol L-48
low, this
ct is well
Samples
quest.

Vanesta

A *NEW* Starch Stabilizer

R·T·VANDERBILT·CO·N·Y·S·AMERICAN PRODUCTS
VANESTA

Stops Gelling

Improves Flow

Gives Uniform Consistency

Sample on request

R. T. VANDERBILT CO., INC.

230 Park Avenue, New York 17, N. Y.

Toys as well as textiles?

Yes, National Aniline is the principal producer of non-toxic Certified Colors for toys . . . colors that are completely harmless if youngsters, as youngsters will, use their toys for teething rings.

National Aniline pioneered this contribution to child health just as it took leadership in color developments for plastics, soap, leather, paper, foods, drugs, cosmetics, biological stains and in every other field where aniline dyes are used.

Our unequalled composite experience, available through National Technical Service, can be helpful in solving your next difficult dyeing problem.

National Aniline

DIVISION OF

ALLIED CHEMICAL & DYE CORPORATION

40 RECTOR STREET NEW YORK 6, N. Y.

BOSTON · PROVIDENCE · PHILADELPHIA · CHICAGO · SAN FRANCISCO · CHARLOTTE
GREENSBORO · ATLANTA · NEW ORLEANS · CHATTANOOGA · PORTLAND (ORE.) · TORONTO

for

REDS

of radiant beauty

AMANIL NAPTHOLS ★ FAST COLOR SALTS OR BASES ★ STABILON

Ideal combinations for perfect coloring throughout the red range and into gold . . . everything you need for complete satisfaction in Napthol dyeing and printing. » » » Let us demonstrate the A.A.P. way to best results with the Napthol process; just call our nearest office, and an A.A.P. technician will gladly visit your plant.

AMERICAN ANILINE PRODUCTS, INC., 50 Union Square, New York, N. Y. — Plant: Lock Haven, Pa.

Branches: Boston, Mass.—Providence, R. I.—Philadelphia, Pa.—Charlotte, N. C.—Chicago, Ill.—Los Angeles, Cal.—Chattanooga, Tenn.—Dominion Anilines & Chemicals Ltd.—Toronto, Canada—Montreal, Canada.

ONYX IONICS

Newsworthy Items for Textile Technologists and Production Men

Volume 1 | May, 1947 | Number 3

NEW DEVELOPMENTS

For Further Details Write Onyx

Material Improvement in Sanforizing is obtained when the goods, prior to shrinking, are passed through a 1% solution of Phi-O-Sol. This powerful wetting and penetrating agent insures hydroscopic and easily wetted goods with ultimate superior "shrinkproofness." No. 53

Assuring Level Shades on All Piece Goods, unions and pile fabrics, Onyx NSAE (Naphthalene Sulfonic Acid Ester) is highly concentrated and requires smaller amounts than other penetrants. Works in neutral alkaline or acid solution and is unaffected by hard water, acids, alkalies, hydrosulfites, bleaching liquids or mordanting agents. No. 54

A Smooth, Mellow Hand on Rayon Taffeta is best obtained by the use of Onyxsan S followed by partial drying and hot calendering while still slightly damp. No. 55

Moth Repellency of Superior Resistance to Dry Cleaning is obtained by treating wool with Amonyx T—an Onyx quaternary ammonium compound which also has exceptional germicidal and fungicidal action. No. 56

Effective Crush Resistance on All Cellulose Fabrics is an outstanding function of Onyx NCF Paste. This urea formaldehyde compound imparts a durable and crush resistant finish. No. 57

What Do You Want In Water Repellency?

If you want the utmost in durability, for cotton-rayon, acetate-rayon and many all rayon, acetate and nylon constructions, Repel-O-Tex D3 and D4 not only give you really durable water repellency, but cut your costs by worthwhile margins. These complementary materials are also applicable to other textiles with less durable results.

If you are interested only in fugitive repellency, Repel-O-Tex 115B provides an economical treatment for any textiles.

All Repel-O-Tex water repellency treatments require no curing. Goods are handled in the usual manner.

Alkyl Dimethyl Benzyl Ammonium Chloride BTC 50%

Onyx manufactures this powerful cationic germicide and fungicide under rigidly controlled conditions to hold the chemical constitution of the alkyl radical within the limits which insure maximum bactericidal action.

Amonyx T is another cationic germicide in the Onyx series of quaternary ammonium compounds. Tests on the value of this particular material for mildew control in textiles have been consistently favorable.

Non-Ionic Surface-Active Detergent and Emulsifier with Unusual Dispersing Action

Neutronyx 330 provides exceptional dispersing effects and emulsifying action together with complete compatibility to electrolytes, hard water, normally met with concentrations of acids and alkalies, and all anionic or cationic surface-active agents.

It is particularly valuable as an auxiliary detergent in hard water conditions, and has shown unusual results as an assistant in the chlorination of wool for shrinkproofing.

Neutronyx 330 is very useful as a leveling agent or retarder in acid dyeing of wool. It has the added advantage of not adsorbing on textile fibres.

PERFORMANCE

Surface Tension (Dynes per Cm.) DuNouy Tensiometer (25°C.)

Concentration	Dynes
0.5%	34.5
0.1%	35.2
0.01%	35.4

Wetting Action (Draves Test)

Concentration	25°C.	60°C.
0.5%	215 Sec.	27 Sec.
0.2%	5 Min. Plus	56 Sec.
0.05%	"	170 Sec.

Detergency

Hunter Reflectometer with standard soiled cotton before and after washing.

Concentration	Per Cent
0.1%	13.5
0.05%	11.9

With addition of 0.25% TSPP

0.1%	22.8
0.05%	15.0

It is in wide use on other textiles in such applications as: a scouring assistant for rayon and acetate; a dispersing and solubilizing agent for acetate colors, as well as for pigments in organic vehicles; and as an assistant to improve exhaustion of anionic or cationic hosiery finishes. It is a good wetting agent in warm water, and shows unusual stability against hardness, electrolytes and both anionic and cationic surface-active agents.

Onyx Resin Finishes Are Fitted to the Specific Job

Synthetic resin finishes of considerable versatility are sometimes desirable. Onyx Xyno Resin AA40—a vinyl resin dispersion—is capable through suitable manipulation of providing a wide range of finishes from a full, mellow hand to a good stiff body on cotton, acetate and rayon. Since it can be mixed with starch, glue, gelatine and water repellents, further versatility is afforded.

On the other hand, a far more specialized resin finish is desirable more often than not. Onyx Resin S-69 is an excellent example. This solvent-free special copolymer resin dispersion was developed to provide a dry, "springy" hand, and is proving of considerable value for nylon and other nettings.

Onyx Resin 362, a viscous vinyl resin dispersion, is peculiarly valuable for imparting a special stiff finish on organdies, marquisettes, ninons, etc., while Eternalure D-15 is still another example of a specialized resin finish.

If you are interested in a specific resin finish for any particular textile, consult an Onyx salesman or technician.

Why the Onyxsans Give a Superior "Hand"

The durability and versatility of an Onyxsan finish are the result of deliberate "tailoring" of the cation in these cation-active softening agents to meet the technical requirements involved.

First the actual size of the ionic particles must be made small enough to be able to penetrate the tiniest tubular capillary passages of the textile fibre.

Then the balance between the water-soluble part of the cation (which carries the charge) and the water-*insoluble* part must be such that combination *throughout* the textile fibre is possible without loss of solubility and penetrating action.

But the most distinctive feature of Onyxsan finishes is the effect of their "tailored" chemical structure which leads to orientation of the cation on the surface of the fibre to produce the effect of millions of tiny extending hair-like structures which gives the unique, soft, mellow hand marking an Onyxsan finish.

For a Full, Mellow Hand on Nylon Hose

Nylons finished with Eternalure D-15, the one-treatment resin finish, have greatly improved snag resistance, clarified and tightened stitch and desirable body without excessive stiffness. "Eye appeal" is notably improved on every gauge and denier hose.

From the finisher's viewpoint, Eternalure D-15 has many advantages. The treatment is easy to apply without changes in equipment or operations. Hose, particularly sheer types, are easier to handle after boarding. Deposits do not build up on the forms, and hose do not stick.

onyx

Onyx Oil & Chemical Company

JERSEY CITY 2, N. J.

CHICAGO • PROVIDENCE • CHARLOTTE • ATLANTA • LOS ANGELES

In Canada: Onyx Oil & Chemical Co., Ltd. Montreal, Toronto, St. Johns, Que.

For Export: Onyx International Jersey City 2, N. J.

■ Calcium Nitrate

REAGENT • PURIFIED • TECHNICAL

Available forms range from the four-water crystal reagent grade product assaying 101-104% $Ca(NO_3)_2 \cdot 4H_2O$, (35% H_2O) to the essentially anhydrous technical grade assaying 98% min. $Ca(NO_3)_2$, (2% H_2O). All are low in metallic impurities, particularly copper, nickel, iron and manganese. Such a selection provides a product suitable for any of the industrial applications of Calcium Nitrate, some of which are: in the production of rubber goods; starch adhesives; radio tubes and electric light bulbs; explosives, matches and pyrotechnics; in the preparation of heat transfer salts and compositions for treating incandescent mantles; as well as a number of patented processes.

For Your Fine Chemical Needs★

■ Potassium Nitrite

TECHNICAL AND CRYSTAL, REAGENT

Production of technical grade Potassium Nitrite in commercial quantities was pioneered by Baker & Adamson Research to meet vital wartime needs. Now this Fine Chemical is available to Industry exclusively from B&A for a host of wide-ranging uses, including: regeneration of heat transfer salts; removal of scale from tungsten rods; manufacture of diazo dyes; as a rust inhibitor, etc. The fused lump technical grade assays 90% min. KNO_2.

Rely on General Chemical's

■ Zinc Formate

Another example of a laboratory chemical brought into commercial production by B&A to meet customer requirements. The purified grade offered is in white, free-flowing granular form, assaying 99.5% $Zn(CHO_3)_2 \cdot 2H_2O$, and low in metallic impurities. New as an industrial chemical, Zinc Formate holds promise in many fields. Suggested uses include: as a catalyst in manufacture of methyl alcohol; production of pure zinc oxide; agent for waterproofing cellulosic materials and weighting silk, etc.

Baker & Adamson Division

★ This is the second in a series of advertisements reviewing the B&A Fine Chemicals commercially available to American Industry today from the Baker & Adamson Division of General Chemical Company. Scores of such purity products await your investigation. To learn more about these or other B&A Fine Chemicals that meet your requirements, write or phone nearest B&A Sales and Technical Service Office.

GENERAL CHEMICAL COMPANY

BAKER & ADAMSON DIVISION

40 RECTOR STREET, NEW YORK 6, N. Y.

Sales and Technical Service Offices: Albany* • Atlanta • Baltimore • Birmingham* • Boston • Bridgeport Buffalo* • Charlotte* • Chicago* • Cleveland* • Denver • Detroit* • Houston • Kansas City Los Angeles* • Minneapolis • New York* • Philadelphia* • Pittsburgh* • Providence • St. Louis* San Francisco* • Seattle • Wenatchee (Wash.) • Yakima (Wash.)
In Wisconsin: General Chemical Wisconsin Corporation, Milwaukee, Wis.
In Canada: The Nichols Chemical Company, Limited • Montreal* • Toronto* • Vancouver*

SETTING THE PACE IN CHEMICAL PURITY SINCE 1882

FINE CHEMICALS
BAKER & ADAMSON B&A QUALITY
STANDARD OF PURITY
FOR AMERICAN INDUSTRY

*Complete stocks carried here.

DEVELOP YOUR COLORS

with U. S. P.

SOLVAY Sodium Nitrite

The secret of quality azo dyes

Leading dye makers and textile dyers *consistently* specify SOLVAY Sodium Nitrite to develop their azo dyes . . . *Experience* has proven to them that when they specify "Solvay," they get *quality* colors. If *you* want quality, specify SOLVAY.

SOLVAY SALES CORPORATION

Alkalies and Chemical Products Manufactured by The Solvay Process Company

40 Rector Street **New York 6, N. Y.**

BRANCH SALES OFFICES:

Boston • Charlotte • Chicago • Cincinnati • Cleveland • Detroit • Houston
New Orleans • New York • Philadelphia • Pittsburgh • St. Louis • Syracuse

SOLVAY
TRADE MARK REG. U. S. PAT. OFF.
SODIUM
NITRITE
(U.S.P.)

SULFRAMIN

A SYNTHETIC ORGANIC DETERGENT; EFFECTIVE EVEN IN DILUTIONS OF *1 to 10,000*

OF SPECIAL INTEREST TO THE TEXTILE INDUSTRY . . .

SULFRAMIN DT and SULFRAMIN LW (Powder) Powerful synthetic detergents and foaming agents unsurpassed wherever hard water presents a problem. LW has a higher lauric content, and consequently is preferred when used in water colder than 50° C. Textile processors and manufacturers of dyeing assistants, use either type, depending upon the temperature of the solution.

SULFRAMIN DH (Paste) A concentrated, slightly alkaline detergent offering great money value as an all around boil-off compound. It is adaptable to the manufacture of various scouring, boiling-off and dyeing assistants; and is usable under any water conditions.

SULFRAMIN DR A neutral compound of high wetting and scouring qualities, having the appearance of a clear, sulphonated oil. It is immediately soluble in hot or cold water, and is therefore an ideal dyeing assistant. It can be employed advantageously as a straight product or in conjunction with various sulphonated oils.

SULFRAMIN DHL A clear, leveling agent having the appearance of a sulphonated oil; and suitable for solving your most vexing dyeing problems. It has powerful leveling and penetrating qualities, and assures complete satisfaction in the processing of rayon and acetate fabrics.

SULFRAMIN DT (Paste) A strictly neutral, synthetic detergent, with good wetting qualities and complete resistance to hard water. Manufacturers of dyeing assistants, and textile processors, use it principally in scouring and dyeing preparations. Being neutral, DT is particularly useful in alkaline solutions.

SULFRAMIN N This is a non-foaming wetting agent, having the appearance of a heavy paste. Although of radically different chemical structure, Sulframin N shares many of the advantages inherent in many of the other Sulframin products. Its strongest feature is its complete immunity to the effects of inorganic acids and alkalies. Consequently, it is preferred in the processing of wool, such as in carbonizing, in dyeing, etc. Not only is Sulframin N an outstanding leveling agent; it can also be safely employed with any amount of alkali.

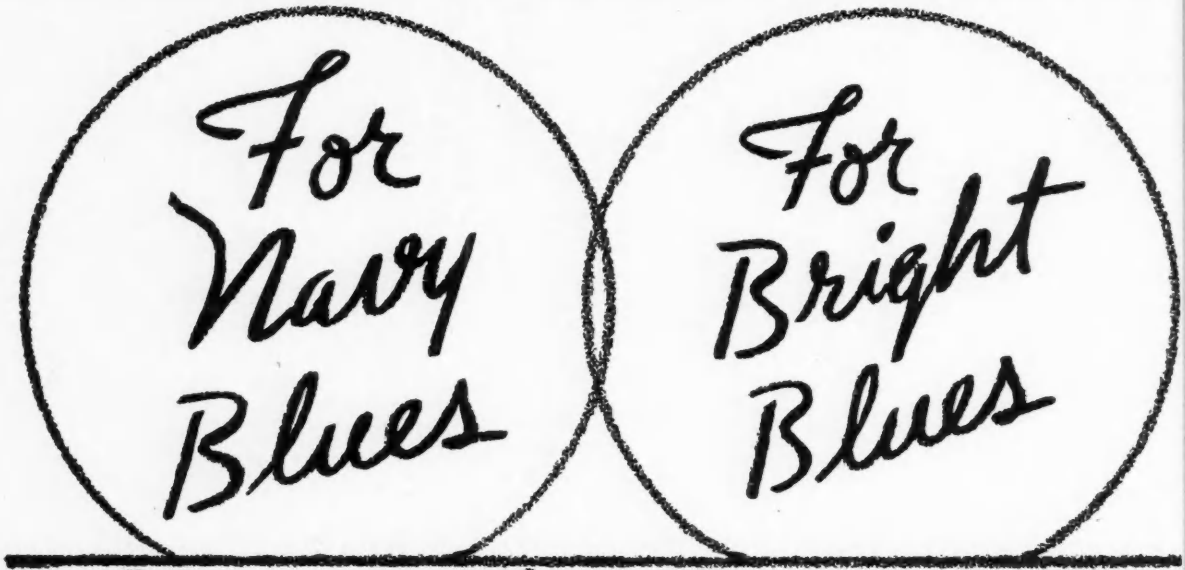
ULTRA Chemical WORKS

ULTRA CHEMICAL WORKS, Inc.

• PATERSON, N. J. • *IN CANADA . . . Delta Chemical Company, Brantford, Ontario*

• CHICAGO, ILL. • *IN MEXICO . . . Icar, S. A., Mexico, D. F.*

May 5, 1947



Pharmasols

Blue GNXX
Blue GDNN

THESE azoic colors, for printing cotton, linen or rayon, produce Navy Blue of good fastness at a low cost. In combination with the Pharmasol Yellows they produce deep Browns.

PHARMASOLS are stabilized solutions, adjusted to the most practical concentration, which can be easily applied with a maximum of efficiency.

PHARMASOLS do not decompose and thereby they overcome the otherwise problems of troublesome dissolving.

Indigosol

BLUE IBC

THE outstanding soluble vat color for producing bright Blues in any depth, of excellent fastness, is Indigosol Blue IBC. It is suitable for dyeing, padding and printing on cotton, linen or rayon (excepting acetate fibers) where maximum fastness is required.

Indigosol Blue IBC is an important member of the group of very fast Indigosols, all of which are readily soluble and easily developed.

CARBIC COLOR AND CHEMICAL CO., INC.

451-453 Washington Street, New York City

BRANCHES:
PHILADELPHIA
PROVIDENCE HAMILTON, ONT.
CHARLOTTE, N. C.

IMPORTERS OF THE MANUFACTURES OF
DURAND & HUGUENIN S. A.
BASLE, SWITZERLAND

EXCLUSIVE DISTRIBUTORS OF
PHARMASOLS
PHARMOLS
PHARMACINES

Representatives: Los Angeles (Hathaway Allied Products)

AMERICAN DYESTUFF REPORTER

LOUIS A. OLNEY, D.Sc.
Directing Editor

NORMAN A. JOHNSON, B.T.C.
Managing Editor

MYRON D. REESER
Advertising Manager

GRACE B. BURTON
Production Manager

M. H. MORGAN
Circulation Manager

Official Publication of the Proceedings of the American Association of Textile Chemists and Colorists

Published every other Monday by
HOWES PUBLISHING COMPANY, INC.
One Madison Avenue, New York 10, N. Y.

A. P. HOWES
President

C. R. HOWES
Vice President

H. F. CRAWFORD
Treasurer

M. D. REESER
Secretary

C. ESSENBREIS
Asst. Secretary

Also Publishers of
KNIT GOODS WEEKLY
TEXTILE COLORIST
AND CONVERTER

MAY 5, 1947

VOLUME 36 NUMBER 9

Contents

Contents of previous issues can be found by consulting the Industrial Arts Index at your library

• Special Articles

Study of the Wetting of Textile Materials: The Use of a Hydrometer Method 225
I. J. Gruntfest, O. B. Hager and H. B. Walker

Determination of Residual Silica on Cotton in Peroxide Bleaching 227
Bertha DuBose and V. B. Holland

The Apermeter: A New Air Permeability Determination Apparatus 245
John H. Skinkle and Arthur J. Moreau

• Departments

Abstracts from Contemporary Journals 247

Patent Digest 248
Paul Wengraf

Trade Notes—New Products 250

• Proceedings of the American Association of Textile Chemists and Colorists

Structure of Protein Fibers P230
Frederic R. Senti

Membership Applications P237

Spring Meeting, Piedmont Section P237

Calendar P237

Metachrome Dyeing—Part II: Minimizing the Adverse Effect of Iron on Fastness of Chrome Colors Through Use of the Metachrome Method of Dyeing P238
Charles H. A. Schmitt

Employment Register P244

Meeting of Rhode Island Section P244

Copyright, 1947, Howes Publishing Co., Inc.

IT'S TRUE...

THE ENTIRE DAILY WATER CONSUMPTION OF NEW YORK CITY DOES NOT EQUAL THE AMOUNT THAT ROLLS OVER NIAGARA FALLS IN JUST 7½ MINUTES!

IT'S TRUE OF ESSO SOLVENTS

THE LARGEST PETROLEUM RESEARCH LABORATORIES IN AMERICA PROVIDE EXPERT TECHNICAL SKILL IN THE PRODUCTION OF **ESSO SOLVENTS** . . . . . ONE REASON WHY CONSTANT UNIFORMITY AND SUITABILITY IN ALL 11 GRADES IS ASSURED.

Hundreds of industries meet all solvents requirements by calling in an Esso representative. His honest, friendly advice might benefit you. Contact him next time a problem comes up.

STANDARD OIL COMPANY OF NEW JERSEY
Elizabeth, N. J.—Baltimore, Md.—Richmond, Va.—Charleston, West Va.—Charlotte, N. C.—Columbia, S. C.—New Orleans, La.—Little Rock, Ark.—Memphis, Tenn.

STANDARD OIL COMPANY OF PENNSYLVANIA
Philadelphia, Pa.

COLONIAL BEACON OIL COMPANY
Boston, Mass.—New York, N. Y.

AMERICAN
DYESTUFF REPORTER

VOLUME 36 MAY 5, 1947 NUMBER 9

Study of the Wetting of Textile Materials

The Use of a Hydrometer Method

I. J. GRUNTFEST, O. B. HAGER and H. B. WALKER

Contributed from Physical Chemistry Research Laboratory of the Rohm & Haas Co. Philadelphia, Pennsylvania

Abstract

The use of a hydrometer method for the study of the wetting of textile materials permits observations to be made over the complete range of "wetnesses" of the sample. It appears that solutions which show short Draves sinking times do not wet the material as thoroughly as solutions which show longer Draves sinking times. Some implications of this result and other applications of the hydrometer method are discussed.

As in the case of many other heterogeneous reactions, the rate determining steps in some of the reactions involved in the wet processes used in the textile industry are not the reactions themselves but rather the penetration or diffusion of the reagent or reagent solution to the reaction sites. It is for this reason that surface active materials are so generally used in the textile industry as assistants to facilitate this penetration or wetting.

The official method of the American Association of Textile Chemists and Colorists for evaluating materials for this application is the Draves Skein Test (1) in which the time for a weighted skein of grey cotton yarn to sink in a solution of the material under test is observed. Since the actual density of raw cotton is nearly 1.6 (2) the buoyancy of the skein can be unambiguously attributed to the presence of occluded air. The usefulness of this method then seems to depend on the assumption that, since any particular area of the surface of a fiber is either in contact with air or with the liquid, the amount of occluded air can be used as a criterion of the effectiveness of the wetting or contact of the fibers and the liquid.

Without at this time examining the validity of this assumption any further, the Draves Test appears to be subject to the following limitation. At the time of sinking the "wetness" of the skein is far from complete, i.e. the volume of occluded air in the skein is greater than the volume of the cotton. This inadequacy is inherent in all sinking type tests since, even when an unloaded skein sinks, the volume of occluded air is two-thirds of the volume of the cotton.

It is conceivable that the most interesting part of the wetting process is that which takes place in the range of "wetness" which is completely inaccessible to the sinking type test. This was realized by Powney (3) who devised an electrical method for measuring penetration. His ingenious method involves the measurement of the electrical resistance of the wetting solution as a function of time after a barrier of the fabric to be wet is interposed between the electrodes. Interpretation of the results obtained in this way, however, seem to be very difficult in view of the problem of relating the relative conductances observed to absolute "wetnesses."

In the study described here a hydrometer method is used for observing the buoyancy of, or amount of occluded air in, a skein of grey cotton yarn immersed in the wetting solution. These observations are made continuously over a long period of time and cover the complete range of "wetnesses." Farrow and Neale (4) have earlier recorded the use of such a technique for studying the penetration of raw cotton by starch pastes.

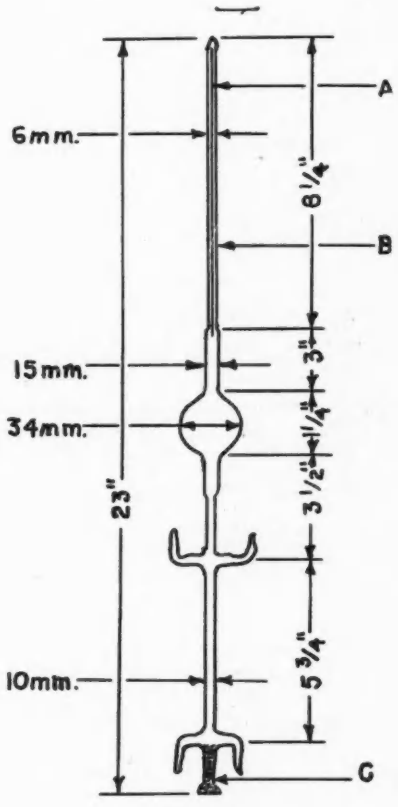


Figure 1

Specially Designed Hydrometer Used in this Study.

A. Scale Made on Graph Paper and Inserted inside Tube.

B. Outside Diameter of Standard Wall Pyrex Tubing Used for Construction is Indicated.

C. Mercury Loading Provides for Level Adjustment and Keeps Hydrometer Floating in Vertical Position.

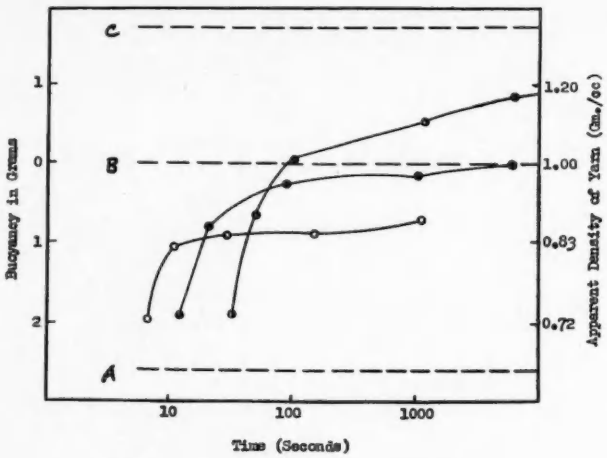


Figure 2

Representative Time-Buoyancy Curves for Five Gram Skeins of Gray Cotton Yarn Immersed in Wetting Agent Solutions. Dotted lines are drawn at buoyancies corresponding to (A) sinking of Draves skein with three gram copper weight. (B) sinking of unloaded material, (C) completely wet clean cotton.

○—0.05% Wetting Agent Solution
●—0.03% Wetting Agent Solution
◑—0.02% Wetting Agent Solution

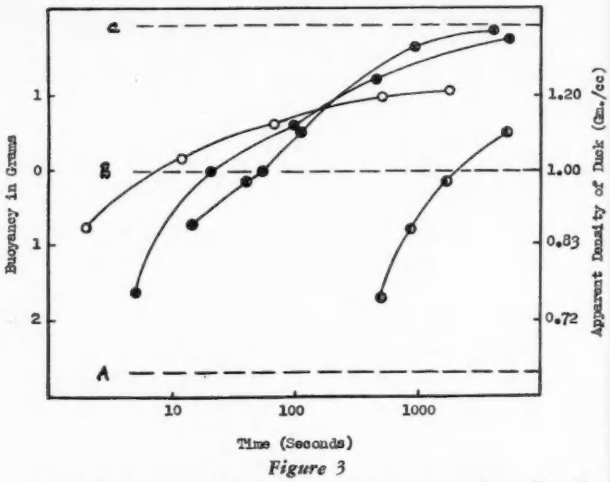


Figure 3

Representative Time-Buoyancy Curves for Five Gram Samples of No. 10 Mt. Vernon Duck Immersed in Wetting Agent Solutions.

Dotted lines have same significance as in Figure 2.

○—0.10% Wetting Agent Solution
●—0.06% Wetting Agent Solution
⊖—0.02% Wetting Agent Solution
◑—Distilled Water

Specially designed hydrometers (Figure 1 have been constructed to which the material to be wet can conveniently be attached and immersed in the wetting solution. Extending the work of Farrow and Neale these hydrometers have been used in this laboratory in three additional applications: (1) for the estimation of the effectiveness of scouring treatments for improving the absorbency of cotton, (2) wetting back studies in which the rate of wetting of a sample of fabric to which surface active material has been applied is observed, and (3) experiments in which the effects of structural features of fabrics on their wetability are examined, as well as for these studies of the effectiveness of wetting agent solutions for wetting grey cotton yarn and fabrics.

Experimental

For the study of the wetting of skeins of grey cotton, standard five gram skeins of grey unboiled 24/2 cotton yarn are used. If these are not cut at the top, as is done in the Draves Test, they can be conveniently draped on the hooks of the hydrometer shown in Figure 1. Samples of fabric (No. 10 Mount Vernon Duck was used in the experiments described here) can be applied to the hydrometer by winding a one inch wide strip, of the appropriate weight, loosely around the bottom stem of the hydrometer and attaching it to the hooks. Small holes in the strip close to the ends are slipped over the hooks for fastening. In connection with the use of uncut skeins, Draves (1) in one of his articles points out that the effect of not cutting the top of the skein in the wetting test is not imporant and this has been confirmed by the work here.

Provision is made for adjusting the level of the unloaded hydrometer by putting mercury in the bottom stem. This also has the effect of making the hydrometer float in a vertical position. Calibration is best accomplished, (assuming selected glass tubing of uniform outside diameter has been used for the upper stem) by calculating the change in weight of the hydrometer as a function of the depth of immersion from the change of volume displacement with depth of immersion.

One liter Nessler type tubes having an overall length of about 24" and an inside diameter of about 2" are used to contain the solution under test.

Results and Discussions

The graphs (Figures 2 and 3) below are representative of the results obtained when the buoyancies of the immersed material are plotted against time. Lines are drawn across the graphs at buoyancies of 2.6 gms., which would intersect the time-buoyancy curves at the time corresponding to the Draves sinking time when using a five gram skein and a 3 gm. copper wt., at 0.0 grams, which would cross the time-buoyancy curves at the time corresponding to the sinking time of an unloaded sample, and at minus 1.87 grams corresponding to the buoyancy of a completely wet sample of clean cotton. The apparent densities of the cotton are computed from the buoyancies and are shown on the right hand ordinate of the graphs.

Attention is directed to the following observation *to which no exceptions have been noted.* In a series of tests of different concentrations of the same wetting agent the more concentrated solutions, which showed the shortest Draves sinking time, did not wet the sample as thoroughly as the more dilute solutions which show longer Draves sinking times. It may also be noted that, barring fortuitous selection of materials, the time to reach buoyancy 2.6 gms. (Draves sinking time) need bear no simple relationship to that required to reach buoyancy zero.

In order to indicate the generality of this effect (the crossing of the time-buoyancy curves), the preparations which have been examined and which gave families of time-buoyancy similar to Figures 2 and 3 are listed in Table I.

It is not proposed that a test of this type replace the Draves test for the routine evaluation of wetting agents, but the large amount of data, of which that shown in Figures 2 and 3 is representative, seems to make desirable a reexamination of the problems of determining the effectiveness of a wetting process and of the relative rating of wetting agents. The selection of the most appropriate wetting agent for a particular application may have to involve consideration of (1) the degree of "wetness" which must be attained for the success of the process, (2) the thickness and tightness of the material being wet, (3) the time of exposure and (4) probably the degree of agitation.

In connection with criteria of the relative quality of wetting agents, two possible outcomes should be considered. ((1)

(Concluded on Page 252)

Determination of Residual Silica on Cotton in

Peroxide Bleaching

BERTHA DuBOSE and V. B. HOLLAND
Cannon Mills Company

IN peroxide bleaching the use of sodium silicate is generally accepted as a necessary practice. The reason for this is its efficiency as a stabilizer in controlling the rate of hydrogen peroxide decomposition, control of alkalinity, detergent action, and protection from otherwise harmful metallic catalysts.[3]

Perhaps the most outstanding drawback in the use of sodium silicates in peroxide bleaching is the residual deposits of silica and insoluble silicates left in the yarn and fabric. This gives rise to undue harshness of yarn and fabric, high ash content and uneven dyeings, if the proper precautions are not observed. The purpose of this study is to develop a satisfactory method for the determination of silica in textiles and to ascertain to what degree silica is deposited on cotton goods during the course of continuous peroxide bleaching; in addition, to determine the effect of varying concentrations of alkaline agents, when used with sodium silicate in treating cotton cloth, on silica deposition.

This study is by no means complete, and is submitted in the hope that it may suggest further investigation which will yield more detailed and enlightening data.

Experimental

The liquid, 42° Bé sodium silicate used in this investigation was of Na_2O . 3.2 SiO_2 composition and of a purity normally used in peroxide bleaching.

The work may be considered in two parts. First, to determine the degree of silica build-up in the fabric during the course of a hydrogen peroxide bleach (in this case, a continuous bleach). Second, after ascertaining the silica content of the cloth before and after bleaching, experiments were conducted in the Laboratory in which varying concentrations of alkaline bleaching agents were applied to fabric with sodium silicate under bleaching conditions, the object of this phase of work being to develop a treatment whereby residual silica in the fabric could be reduced.

Part I:

During the course of bleaching a lot of 64 x 64 sheeting in a continuous rope unit, 10 samples were selected at random over a period of approximately one hour and taken at that point in the range which is between the second J-Box and final washer. The formula of the bleach applied to the goods before entering this J-Box is of the order 1.16% Sodium Silicate, 0.99% 130 vol. Hydrogen Peroxide and 0.27% Caustic Soda 50%. (See Table I).

Detailed information on formulas, equipment and steps in the peroxide continuous bleaching process may be found in the work of Rupp[3] and Campbell[2].

In a like manner samples of 64 x 64 and 96 x 104 sheeting were taken just before and after the final wash in the continuous bleaching range. (See Table II).

All the samples were dried in a steam oven and then subjected to analysis for the following:

Water-Extractable Matter.
Total Alkalinity of Water-Extractable Matter.
Non-Cotton.
Silica.

Part II:

5 gram samples of griege 64 x 64 sheeting were placed in stainless steel dye beakers containing 100 ml. of solution of sodium silicate alone, and solution of sodium silicate with caustic soda, soda ash and tetrasodium pyrophosphate, respectively. These were covered and placed on a steam bath for three hours, after which they were washed thoroughly with tap water, rinsed with distilled water and dried. Silica determinations were run on these samples. (See Table IV).

Method for the Determination of Silica

After considerable preliminary work a procedure was evolved in which the dehydration and separation of silica from

TABLE I
Analysis of 64 x 64 Sheeting after J-Box Prior to Washing
All Samples from the Same Lot of Goods

No.	Sample	% Water Ext. Matter	Alk. of H_2O Ext. Matter in Mg. NaOH/5 g. Sample	% Non-Cotton	Mg. SiO_2/gram Cloth
1	Blank before Saturation	0.64	6.00	1.64	1.49
2	Saturated before J-Box.....	1.04	11.60	2.83	4.47
3	After J-Box before Washing....	1.79	12.80	3.96	4.86
4	After J-Box before Washing....	1.86	11.60	4.04	4.43
5	After J-Box before Washing....	2.25	11.60	4.83	4.43
6	After J-Box before Washing....	1.89	10.80	3.91	4.01
7	After J-Box before Washing....	2.16	11.60	4.62	4.79
8	After J-Box before Washing....	2.01	10.80	4.33	4.43
9	After J-Box before Washing....	1.19	9.20	3.25	4.26
10	After J-Box before Washing....	2.26	10.80	4.90	4.54

TABLE II

Sample	% Water Ext. Matter	Alk. of H_2O Ext. Matter in Mg. NaOH/5 g. Sample	% Non-Cotton	Mg. SiO_2/gram Cloth
Blank				1.49
Before Wash 64 x 64.....	1.62	12.15	1.95	4.10
After Wash 64 x 64.....	0.42	2.58	0.63	2.38
Before Wash 96 x 104.....	1.96	12.15	2.29	4.05
After Wash 96 x 104.....	0.38	3.10	0.70	2.20

TABLE III
Analysis of 64 x 64 Sheeting Treated with Sodium Silicate (Na_2O . 3.2 SiO_2)

Treatment	Residual SiO_2 in mg. / Gram Cloth
Blank	0.32
0.1% Sodium Silicate	0.28
0.2% Sodium Silicate	0.46
0.3% Sodium Silicate	0.67
0.4% Sodium Silicate	0.88
0.5% Sodium Silicate	0.70

TABLE IV
Effect of Alkalies in the Silicate Bath on the Residual Silica in the Cloth
In all treatments a 0.5% silicate solution is used.

Concentration of added Material	Mg. SiO_2 per gram of cloth		
	Caustic Soda	Soda Ash	Tetrasodium Pyrophosphate
Blank			0.32
0.1%	1.79	1.31	0.57
0.2%	1.46	1.25	0.35
0.3%	1.47	1.40	0.34
0.4%	1.44	1.35	0.27
0.5%	1.41	1.24	0.36

TABLE V
Comparison of Results Obtained with Adopted and Condensed Procedures for Silica Determination
64 x 64 Sheeting Treated with Sodium Silicate Solutions

Concentration Sodium Silicate	Mg. SiO_2 gram of Cloth	
	Adopted Method	Condensed Method
Blank—Water	0.32	1.13
0.1%	0.28	1.05
0.2%	0.46	1.25
0.3%	0.67	1.40
0.4%	0.88	1.89
0.5%	0.70	2.18

interfering elements and solution of silica was carried out along the lines proposed by Adams[1]. Following fusion and solution of the silica a modification of the colorimetric silicomolybdate method as found in Snell[4] was employed.

5 gram samples of the fabric were cut into a fine pulp, bone-dried, and one gram carefully weighed into a platinum dish and ashed in the muffle furnace. 1 ml. of 70% perchloric acid was added to each ash and the dish placed on the steam bath for at least 30 minutes. After cooling, about 10 ml. distilled water was added to the dish and the contents filtered through a 5 cm. No. 40 Whatman paper. The perchloric acid was completely removed by washing with cold water.

The filter was put back into the platinum dish and the walls of the dish carefully washed down with distilled water. After drying on a steam bath, 5.1 grams anhydrous, cp sodium carbonate was added and the dish placed back into the muffle furnace to ash the filter paper. Then, using a meker burner, the sodium carbonate and silica residue were fused to a clear quiescent melt.

While hot, the dish was immersed in cold distilled water so as to shatter and break loose the melt. This was warmed until complete solution took place and then neutralized with 75 ml. HCl (250 ml. conc. HCl made up to 2000 ml. with distilled water). After carefully transferring to a 250 ml. volumetric flask and making up to the mark with distilled water, 75 ml. aliquots were placed in a 100 ml. vol. flask and treated with 2 ml. 10% ammonium molybdate solution and 2 ml. glacial acetic acid. After exactly five minutes, readings were taken on a Klett-Summerson Photoelectric Colorimeter using a blue filter and adjusted to a blank treated the same way, but minus the silica.

The knowns were run in duplicate and the silica content calculated by reference to a curve plotted from a series of knowns run as above.

The ammonium molybdate reagent and standard silicate solutions were stored in hard rubber bottles to prevent the silica contamination that might be expected if glass containers were used.

Discussion

During the course of the investigation an attempt was made to reduce the time required for the analysis. In this procedure the samples were cut into a fine pulp, bone-dried, and weighed carefully into a platinum dish where it was covered with 5.1 grams of anhydrous sodium carbonate and fused. The dissolving of silicate and development of color followed as in the method adopted. Due to the presence of interfering substances, particularly iron and phosphates which develop color complexes, the results were too high, so that the condensed procedure could not be adopted. This is shown in Table V.

Recoveries verified this further.

The results of this work substantiate the generally accepted theory that residual silica deposits are left in cotton during the course of peroxide bleaching processes. This is illustrated in Tables II, III, and IV.

In Table IV are results which demonstrate the effect of three substances, commonly used in peroxide bleaching, on the degree of residual silica in the cloth when used with sodium silicate in the bath. As would be expected, the tetrasodium pyrophosphate tended to reduce residual silica to a minimum whereas the caustic soda and soda ash caused a very pronounced increase in residual silica in the goods. However, under certain conditions soda ash has been used with good results in kier boiling as an after treatment for peroxide bleached goods to greatly reduce the ash content.

Among other things, this investigation suggests studies of the effect of time and temperature on the silicate or bleach bath on the rate of residual silica deposition on the goods, further experimentation to bring about reduction in residual silica deposits, and the effects of sodium silicate composition and purity of residual silica.

Summary

A method for the determination of silica in fibers, yarns, or fabrics of cotton, is submitted which is based on ashing, removal of interfering substances with perchloric acid, fusing and the development of the silicomolybdate complex for color measurement. Typical analyses of residual silica in cotton sheeting are shown from samples selected during the course of a continuous peroxide bleaching process. In addition, the effect of caustic soda, soda ash and tetrasodium pyrophosphate in the silicate bath on residual silica deposition on the cloth is indicated.

Bibliography

[1] Adams, M. F.; "Determination of Small Amounts of Silica," Ind. & Eng. Chem., Anal. Ed., Vol. 17, 1945, page 542.

[2] Campbell, D. J.; "Procedure and Equipment for Bleaching Cotton Goods with Peroxide by the Continuous Method," Amer. Dyestuff Reptr., Vol. 33, 1944, page 293.

[3] Rupp, R. E.; "Continuous Peroxide Bleaching as Developed in the Piedmont Section", Amer. Dyestuff Reptr., Vol. 31, 1942, page 638.

[4] Snell, Foster D. and Snell, Cornelia T.; "Colorimetric Methods of Analysis." Vol. I, D. Van Nostrand Co., Inc., New York 1946, page 517.

[5] Vail, James G.; "Soluble Silicates in Industry." The Chemical Catalog Co., Inc., New York 1928, pp. 344-348.

Proceedings of the
American Association of Textile Chemists and Colorists

MAY 5, 1947

National Officers of the Association

President
HENRY F. HERRMANN
General Dyestuff Corp., 435 Hudson Street, New York 14, N. Y.

Vice-Presidents
C. NORRIS RABOLD
Union Bleachery, Greenville, S. C.
JOHN N. DALTON
Pacific Mills, Lawrence, Mass

Treasurer
WILLIAM R. MOORHOUSE
National Aniline Division, Allied Chemical & Dye Corp., 150 Causeway Street, Boston 14, Mass.

Secretary
HAROLD C. CHAPIN
Lowell Textile Institute, Lowell, Mass.

President Emeritus and Chairman of the Research Committee
LOUIS A. OLNEY
Lowell Textile Institute, Lowell, Mass.

Director of Research
HAROLD W. STIEGLER
Lowell Textile Institute, Lowell, Mass.

COUNCILORS
Representing Sections

Rhode Island: HOWARD V. KING, HAROLD B. STURTEVANT, RALPH F. CULVER.

Philadelphia: CURT R. BAERINGER, LLOYD O. KOONS, ARTHUR W. ETCHELLS, BOYCE C. BOND, PERCIVAL THEEL.

New York: PATRICK J. KENNEDY, LEONARD S. LITTLE, THOMAS F. O'BRIEN, GEORGE L. BAXTER, EMMETT J. DRISCOLL, WINN W. CHASE, HAROLD H. TAYLOR.

Northern New England: EDWARD S. CHAPIN, WALTER J. HAMBURGER, DELBERT E. RAY.

Piedmont: SIDNEY M. CONE, RAPHAEL E. RUPP, LELAND G. ATKINS.

Southeastern: WILLIAM B. GRIFFIN.

South Central: WILLIAM E. REID

Mid-West: ERIC W. CAMP, SAMUEL KLEIN.

Past Presidents

ELVIN H. KILLHEFFER, P. J. WOOD, WILLIAM H. CADY, ALBAN EAVENSON, CARL Z. DRAVES, THOMAS R. SMITH, WILLIAM D. APPEL.

Standing Committees of the Council and their Chairmen

Executive Committee on Research
J. Robert Bonnar, Chairman

Publicity
Winn W. Chase, Chairman

Conventions
Kenneth H. Barnard, Chairman

Appropriations
William R. Moorhouse, Chairman

Constitution and By laws
Harold C. Chapin, Chairman

Membership and Local Sections
John N. Dalton, Chairman

Corporate Membership
Emmett J. Driscoll, Chairman

Publications
Louis A. Olney, Chairman

Technical Programs
Miles A. Dahlen, Chairman

Local Sections and their Officers

Northern New England Section

Chairman
George O. Linberg, Monsanto Chemical Co., 140 Federal Street, Boston 10, Mass.

Secretary
Azel W. Mack, Dexter Chemical Corp., 581 Boylston Street, Boston 16, Mass.

Vice-Chairman — Frank J. O'Neil
Treasurer — Martin H. Gurley, Jr.

Rhode Island Section

Chairman
George H. Wood, Jr., 40 Valentine Circle, Apponaug, R. I.

Secretary
Emory A. Richards, Airedale Worsted Mills, Inc., 928 Park Ave., Woonsocket, R. I.

Vice-Chairman — Robert W. Joerger
Treasurer — Robert F. Farwell

New York Section

Chairman
Herman E. Hager, General Dyestuff Corp., 435 Hudson Street, New York 14, N. Y.

Secretary
Norman A. Johnson, American Dyestuff Reporter, One Madison Ave., New York 10, N. Y.

Vice-Chairman — Charles W. Dorn
Treasurer — John H. Hennessey

Philadelphia Section

Chairman
Walter Fancourt III, W. F. Fancourt & Co., 516 S. Delaware Ave., Philadelphia 47, Pa.

Secretary
A. E. Raimo, John Campbell & Co., S. E. Corner Broad and Spring Garden Sts., Philadelphia 23, Pa.

Vice-Chairman — Arthur M. Gordon
Treasurer — James Dixon

Piedmont Section

Chairman
Wyss L. Barker, National Aniline Division, Allied Chemical & Dye Corp., P. O. Box 659, Charlotte 1, N. C.

Secretary
Robert H. Smith, Melrose Hosiery Mills, High Point, N. C.

Vice-Chairman — John B. Neely
Treasurer — Roy J. Beauregard

South Central Section

Chairman
Jack Anderson, Peerless Woolen Mills, Rossville, Ga.

Secretary
Charles A. Spratt, National Aniline Division, Allied Chemical & Dye Corp., Chattanooga, Tenn.

Vice-Chairman — William J. Kelly
Treasurer — Robert J. Quigg

Mid-West Section

Chairman
Al. J. Feit, E. I. duPont de Nemours & Co., Inc., 7 S. Dearborn Street, Chicago, Ill.

Secretary
George B. Chabot, Jr., Calco Chemical Division, American Cyanamid Co., 146 W. Kinzie Street, Chicago, Ill.

Vice-Chairman — George E. Osha
Treasurer — Joseph H. Jones

Southeastern Section

Chairman
A. Kempton Haynes, Rohm & Haas Co., Inc., 1811 Meadowdale Ave., N. E., Atlanta, Ga.

Secretary
Howard M. Waddle, West Point Mfg. Co., Shawmut, Ala.

Vice-Chairman — Matthew T. Barnhill
Treasurer — Allyn J. Morse

Student Chapters

Lowell Textile Institute
North Carolina State College
Philadelphia Textile Institute
New Bedford Textile Institute
Georgia School of Technology

Members should notify the Secretary immediately of all address changes

Structure of Protein Fibers*

FREDERIC R. SENTI

*Eastern Regional Research Laboratory**
Philadelphia 18, Pennsylvania

NATURAL organic textile fibers belong to only two compositional groups—the cellulosic group, represented by such fibers as cotton, flax and jute, and the protein group, represented by wool, mohair and silk. With each fiber are associated characteristic properties which recommend as well as limit it to particular uses. Cotton, and cellulose fibers in general, possess high strength, low extensibility, and good water resistance; wool is valued for the warmth, resilience, crease- and crush-resistance of its fabrics, while silk possesses both considerable strength and resilience and is unique among the natural fibers in that it occurs as a continuous filament.

Because silk was an expensive and relatively scarce fiber, the first experiments, made about a century ago, were directed toward producing an artificial fiber with the properties of silk. Curiously, this work resulted in the production of rayon, a regenerated cellulosic fiber rather than a regenerated protein fiber. The first rayons produced were weak, particularly when wet, and were considered by many to be an ephemeral invention. Today rayons are available in a great range of strengths and elongations—the high-tenacity viscose and saponified acetate fibers are now produced with strengths of 6 to 9 grams per denier, strengths once considered impossible to achieve. Even though the rayons far exceed silk and wool in strength, they fail to replace these fibers in many fabrics. Silk is preferred for hosiery and sheer dress goods, wool for suits, blankets and carpets. The property of silk and wool largely responsible for their use in these materials is the ability to recover from large deformations, whether produced by stretching, twisting or crushing.

Since all proteins are alike in that their molecules have the same basic structure, the polypeptide chain, it would appear that some of the non-fibrous proteins might well be modified to make a silk- or wool-like fiber. This idea is not new, for patents appeared about 1900 describing methods of spinning casein, the protein of milk, into fibers. It was not until the last decade, however, that artificial protein fibers appeared on the market both here and abroad. These fibers, known as Lanital in Italy, Lactofil in the Netherlands and Aralac in this country, are spun from casein. Experimental work has been reported on fibers from many other proteins—chief among these are the proteins of peanuts, soybeans, corn, egg white and feathers. Ardil, a fiber from peanut protein, is being produced on a pilot-plant scale in England.

Whereas the artificial protein fibers, as presently produced, are not outstandingly strong, they are resilient and are similar in many respects to the natural protein fibers. It is desirable to examine in some detail the structures of the natural protein fibers as well as the artificial fibers to find which aspects of these structures contribute importantly to their macroscopic physical properties.

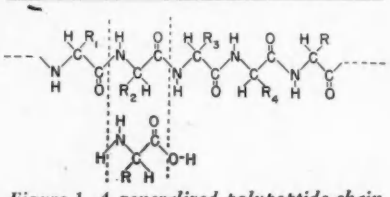
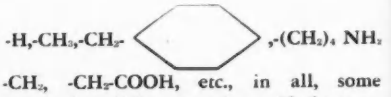


Figure 1. A generalized polypeptide chain. Dotted lines enclose an α-amino-acid residue which is the repeating unit of the chain.

Fundamentally, textile fibers are made up of threadlike molecules of high molecular weight, and protein fibers are no exception to this rule. Symbolically, the polypetitide chain may be represented as in Figure 1. The monomer of this righ polymeric molecule is the α-amino-acid residue, one of which is enclosed by the dotted lines in Figure 1. In contrast to most other high polymers, the polypetide chain is not built by repeating a single monomer or a combination of two or three different monomers, but is a complicated copolymer built from many different monomers. It is true that all the monomers are α-amino acids, but they differ in the nature of the side group R, which may be



-H, -CH_3, -CH_2--, -$(CH_2)_4$ NH_2 -CH_2, -CH_2COOH, etc., in all, some twenty-five different amino acids have so far been isolated from proteins. The properties of any protein or the fiber derived from it must depend on its amino-acid composition, on the arrangement or sequence of the different amino-acid residues along the polypetide chain, the length of the chain, and the spatial configuration of the chain—whether it is extended as a threadlike molecule or is folded into a more or less compact ellipsoidal particle. In any protein fiber, natural or artificial, some of these factors can be changed in moderate degree by chemical or physical treatment. Minor changes in composition of the fiber can be effected by reaction of the side groups R with various small molecules; this is the basis of the hardening or tanning treatments applied to leather and artificial protein fibers, and of the shrink-proofing of wool. Chain length, an important factor in any textile fiber, unfortunately can be varied only in one direction, and that is downward. The arrangement or sequence of the various amino acids along the polypeptide chain of a given protein is inflexible. Only by hydrolysis of the protein into its constituent amino acids and by recondensation into a high polymer could the sequence be affected; at present this process is not feasible. The last consideration, that of the degree of extension or folding of the molecular chains, is directly related to the mechanical properties exhibited by the fibers. It is of primary importance in the artificial protein fibers, for the most abundant source of material for these fibers is the globular proteins whose molecules are composed of polypeptide chains coiled or folded into compact, near-spherical particles, which in this configuration are not suited to fiber formation. To make a fiber of maximum strength, these molecules must be unfolded and arranged with the prevailing direction of their long axis along the fiber axis, much in the manner that a yarn is spun by arranging the individual filaments into a more or less parallel bundle.

A comparison of the structure of silk, wool, collagen, and some artificial pro-

* Based on the paper presented before the Philadelphia Section, November 15, 1946.

** One of the Laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, United States Department of Agriculture.

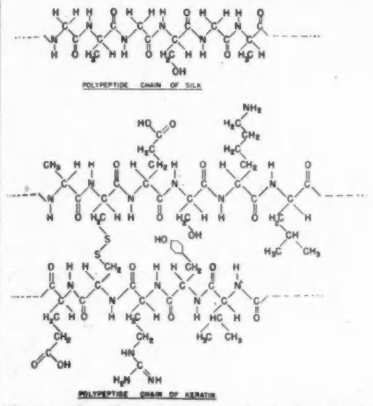


Figure 2. Comparison of polypeptide chains of (a) silk and (b) wool.

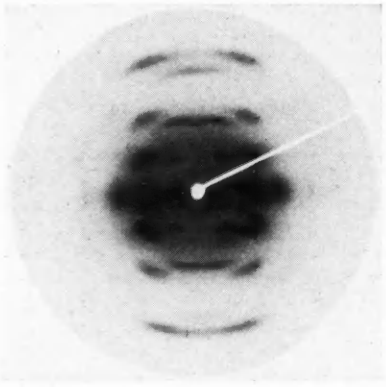


Figure 4. Diffraction pattern of silk.

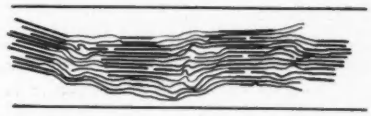


Figure 5. Schematic representation of the amorphous and crystalline regions in a fiber. Heavy straight lines represent chains in a crystalline area (after Mark.)

tein fibers, their composition and physical properties, will serve to illustrate the influence of some of the factors we have mentioned.

Silk

We shall first consider silk. Among the protein fibers, silk is the strongest, its tensile strength ranging from 3.5 to 4.5 grams per denier. Combined with this high strength it has a moderate degree of extensibility, elongating ten to fifteen per cent before breaking. Compositionally, silk is set apart from all other proteins owing to its high content of the simple amino acids, glycine and alanine, these two acids comprising about 75 per cent of the residues in the polypeptide chains. Serine and tyrosine each constitute another 10 per cent of the polypeptide chain. Thus the major part of the molecule is accounted for. In Figure 2 the polypeptide chain of silk is compared with that of wool. The side groups R of glycine and alanine are -H and $-CH_3$ respectively; both are small groups, and since they account for the majority of the side groups of the molecule, the extended polypeptide chain presents a relatively smooth surface, and it may be expected to pack well with its neighbors. Figure 3 is a photograph of scale models of the polypeptide chains of silk and wool and more accurately illustrates the differences in the distribution of matter along the chains.

Direct information concerning the arrangement of the polypeptide chains in silk is gained by a study of its X-ray diffraction pattern, which is presented in Figure 4. For any substance to produce such an X-ray pattern requires that there be a regular, periodic arrangement of its atoms and molecules, an approximation to the spatial order associated with an obviously crystalline substance such as sucrose. Clearly, the entire silk fiber cannot constitute a single crystal, for if this were true, the fiber would be brittle and have very low extensibility, much like asbestos. We are then led to the concept of a fiber composed of crystalline regions interposed with amorphous regions as represented in Figure 5. The amorphous regions contribute mainly to the hazy background of the X-ray diffraction pattern. A molecular chain may run through several such crystalline and amorphous regions. It is the amorphous regions, then, where the chains are less tightly packed and more or less kinked, that allow the fiber to flex and extend moderate amounts without permanent deformation. From this reasoning, it is to be expected that the flexibility and elongation of a fiber will depend upon the relative extent of crystalline and amorphous regions, the fiber becoming less extensible as the proportion of crystalline material increases. Another factor to be considered is the orientation of the molecular chains with respect to the fiber axis. Since primary bonds within a molecule are much stronger than the secondary bonds between molecules, rupture of a fiber occurs mainly as a result of slippage of molecular chains. If the chains all run in the direction of the fiber axis, then the lateral interactions along the considerable length of the molecules must be overcome simultaneously in order to separate them from their neighbors. If the direction of the molecular chains is transverse to the fiber axis, then on application of stress the chains will tend to separate by a zipper action, in which the fracture is propagated by successive rather than simultaneous rupture of lateral bonds along the chains. Consequently, we may expect the tenacity of a fiber to increase as preferential orientation of the molecules in the fiber direction increases. Tenacity should also increase with the chain length or molecular weight for this increases the average number of secondary bonds that must be broken in order to separate one molecule from its neighbors. Orientation is to be distinguished from crystallinity for it refers only to the

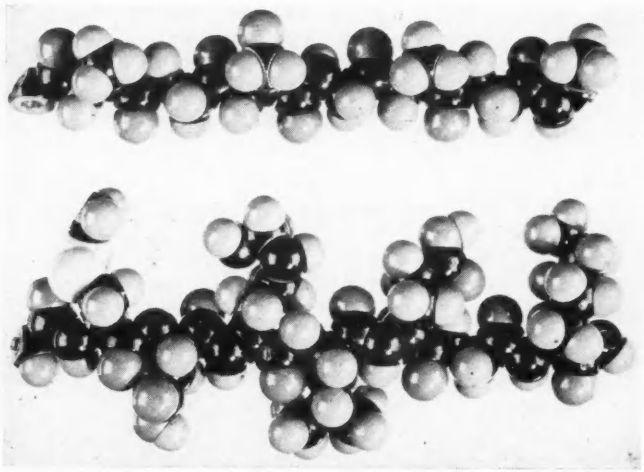


Figure 3. Photograph of scale models of polypeptide chains of a silk (above) and wool.

direction of the molecular chains, whereas crystallinity refers to the perfection of packing of the molecules in all directions. Thus a highly crystalline fiber may not possess orientation, and the converse is also true. Unfortunately, the discrete diffraction pattern of a fiber reflects only the orientation and arrangement existing in the crystalline regions, and we must employ less direct methods to investigate the less ordered or amorphous regions.

Compared to other protein fibers, both natural and artificial, silk is not only highly oriented but is the highest on the crystallinity scale. It also shows the lowest swelling when immersed in water and lowest absorption from the vapor phase. The relationship of these observations is explained by the X-ray evidence, to be described later, that the crystalline portions are not penetrated by water. Although the amorphous portions of silk probably take up as much water at normal humidities as the corresponding regions in other protein fibers,[1] their proportion is less and consequently the overall absorption is decreased. Impermeability of the crystalline regions by water permits relatively large portions of each polypeptide chain to be held firmly in the fiber structure, even though other portions of the chain are separated from neighboring silk molecules by water molecules. High tensile strength is thus maintained even in the wet state.

The position of the spots on the diffraction pattern of silk gives a measure of the arrangement and packing of the molecular chains. To make this statement more clear, let us consider the diffraction of X-rays by a set of polypeptide chains composing a portion of a "crystallite" present in a silk fiber, as illustrated by Figure 6. The atoms are considered to lie in sets of parallel layers both horizontally and vertically, as indicated by the planes drawn in the figure. Each layer behaves like a mirror toward the incoming beam of X-rays, reflecting them continuously as the crystallite is rotated about the vertical axis. Each set of planes then gives rise to a streak across the X-ray film. However, since all layers of a set are illuminated simultaneously by the X-ray beam, destructive interference occurs among the reflected beams, causing neutralization at all angles except one (the Bragg angle), which depends on the separation between the layers. The diffraction pattern of a rotating crystallite thus consists of a set of discrete spots due to the various sets of atomic layers. From the position of the spots we can calculate the distance between the layers and also the angle of inclination of the layers with respect to the axis perpendicular to the X-ray beam.

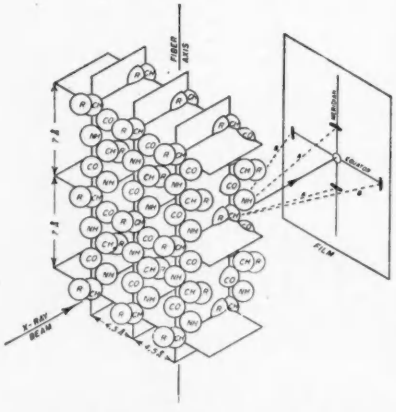


Figure 6. Diffraction of X-rays by a silk crystallite (reproduced from "The Chemistry of Leather Manufacture" by George D. McLaughlin and Edwin R. Theis, American Chemical Society Monograph published 1945 by the Reinhold Publishing Corp., New York).

Interestingly, a silk fiber, or any other textile fiber, need not be rotated in an X-ray beam to produce its diffraction pattern. This is clear evidence that it is a polycrystalline substance, with all the crystallites having one axis along the direction of the fiber, but some of them rotated about this axis so that one set of atomic layers is in position to reflect, while oher crystallites are in reflecting position for other sets of planes. Any deviation of the axis of the crystallites from the fiber axis results in a broadening of the diffraction spots into arcs. The X-ray photograph thus gives a measure of the inclination or "orientation" of the crystallites, and therefore the molecular chains, with respect to the fiber axis.

From the meridian reflections, we calculate that the spacing between planes perpendicular to the fiber axis is 7 Angstrom units (Å). This is very close to the distance computed for two residues of a fully extended polypeptide chain, assuming the bond distances and angles found in small molecules. It is therefore evident that the polypeptide chains are in their fully extended configuration in the crystallites and that the long axis of the molecular chains runs along the fiber axis.

The reflections on the equator of the X-ray pattern are a measure of the lateral spacing of the polypeptide chains. These are the spacings which would be expected to change if water penetrated the crystallites and forced the chains apart. Patterns of wet silk fibers are identical with those given by fibers at normal humidities. It follows that water has not entered the portion of the fiber responsible for the X-ray pattern.

Wool

Wool provides an interesting comparison with silk. Its dry strength ranges from 1 to 1.6 grams per denier, values low compared to silk; but like silk, little strength is lost on immersion in water, although for an entirely different reason. It is further distinguished from silk by its high reversible extensibility. This is especially apparent in the wet state. A wet wool fiber can be extended sixty per cent and upon release it immediately returns to its original length. At normal humidities this property of rapid recovery from deformation is manifest in the resilience of wool and makes for crease-resistant and crush-resistant fabrics.

As shown in Figure 2, the composition of wool results in a polypeptide chain with a very rough surface compared to that of silk. In wool we have 5 per cent of glycine and alanine, 22.5 per cent aspartic and glutamic acids, 10 per cent arginine, 11.5 per cent leucine and isoleucine, about 12 per cent cystine, and amounts of at least nine other amino acids sufficient to account for 85 per cent of the keratin molecule. Very important to the properties of wool is its high content of cystine, which forms sulfur bridges between adjacent polypeptide chains and binds the wool fiber into giant molecular aggregates.

In the normal state, wool gives the X-ray diffraction pattern reproduced in Figure 7. This has been called the "α-keratin" pattern by Astbury.[2] Compared to silk, this pattern signifies a low order of crystallinity in the fiber, both as to perfection and amount. An important feature of the pattern is the reflection

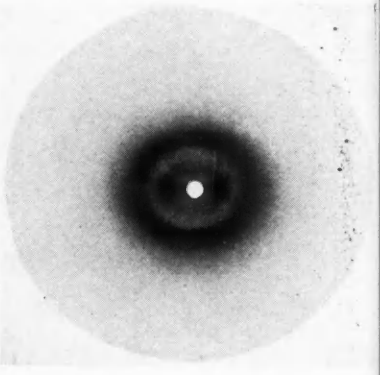


Figure 7. Diffraction pattern of unstretched wool, α-keratin structure.

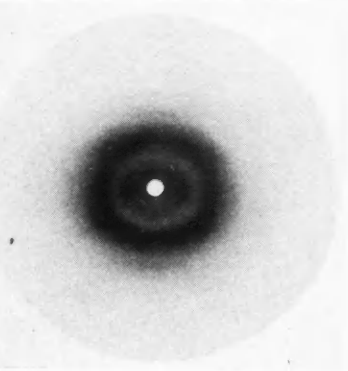


Figure 8. Diffraction pattern of stretched wool, β-keratin structure.

occurring on the meridian, which shows that the repeat period along the polypeptide chain is 5.1 Å as compared to 7 Å in silk. A single amino-acid residue extends 3.6 Å, and two residues in their most extended configuration project 7.2 Å on the fiber axis; to satisfy a repeat period of 5.1 Å it appears that the polypeptide chain must be regularly folded, with two or more amino-acid residues occurring in each fold of the chain.

If wool is stretched 20 to 100 per cent the X-ray pattern transforms to the "β-keratin" shown in Figure 8. A new set of reflections occurs corresponding to a fiber repeat period of 6.7 Å, or more nearly that required by a fully extended polypeptide chain. This transformation is reversible. If the stretched fiber is released in water, it returns almost to its initial length and it gives the original X-ray pattern. The reversible extensibility of wool at extensions greater than 20 per cent is thus associated with a reversible unfolding of the polypeptide chains in the organized portions of the fiber. Thermal-stress data[3] indicate that the elasticity at extensions below 20 per cent is due to a similar mechanism—the tendency of the partially extended chains in the less organized portions to return to a specific folded configuration of lower potential energy. This is to be contrasted with the elasticity of rubber which results from the tendency of the extended polymer chains to kink and coil in a random fashion. It is interesting that the extended polypeptide chains in stretched wool are not in a stable state as they are in silk where the polypeptide chain is normally extended. It is evident that the lateral interactions between the chains, arising from the cystine cross-bonding as well as secondary bonding by hydrogen bridges and polar attractions, are not sufficient to resist the contractile tendency of the system. The cystine cross-bonds may, in fact, favor the folded configuration for if the folds in adjacent chains between successive cystine cross-bonds differ considerably in length, then the system is not permitted to transform entirely into stable extended chain structure. If stretched wool is steamed so that some of the cystine bridges are broken, rearranged spatially, and reformed as the same or another type linkage, a β-keratin configuration results. The process is commonly referred to as "permanent set."

It becomes apparent, too, that the cystine linkages are in large measure responsible for the high wet strength of wool. Water swells wool considerably, plasticizing or lubricating the molecules and permitting them to move readily with respect to each other—but only up to a certain limit. When this limit is reached, at about 100 per cent extension, the full stress is applied to the cross-bonds, which prove to be nearly as strong as all the lateral bonding operative in the dry filaments. If the cystine bonds are broken chemically and not reformed, then wool decreases greatly in wet strength and shows only slight resistance to extension when wet.[4] The dry strength, however, is only slightly affected, showing that the secondary attractions between long chain molecules are sufficient to impart considerable strength.

Collagen

Classified according to their X-ray diffraction pattern, the keratins of wool and hair, and the fibroin of silk fall into the same group, for both are built of polypeptide chains which, when extended, show a fiber repeat period of about 7 Å. On the same basis collagen belongs to a different group of fibrous proteins, since its diffraction pattern (Figure 9) gives a

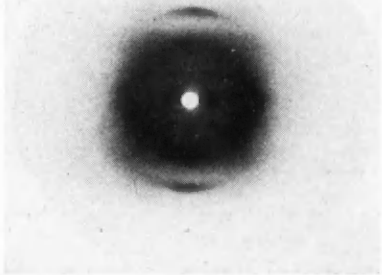


Figure 9. Diffraction pattern of oriented collagen.

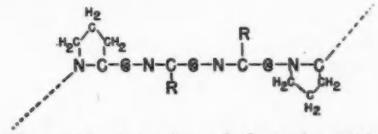


Figure 10. A portion of the polypeptide chain of collagen showing the effect of the proline residues on the direction of the polypeptide chain. The chain is viewed parallel to the plane containing the main-chain bonds of the amino-acid residues. In Figures 1 and 2 the chain is viewed perpendicular to this plane.

repeat distance along the polypeptide chain of 8.4 Å. Like silk, this feature of the X-ray diagram is unaffected by stretching or relaxing the fibers. The molecular arrangement remains the same in the organized portions of the fiber. Only the orientation and total amount of these regions change.

Again we turn to the analytical data for a clue to this new X-ray pattern. The data indicate that about one-third the residues in collagen are glycine, somewhat less than one-third are proline or hydroxyproline, one-ninth are alanine, one-twentieth are leucine, and the greater proportion of the remaining amino-acid residues have polar side groups. It is the high content of proline and hydroxyproline which most likely accounts for the structural difference between collagen and silk or wool. This is because of the peculiar configuration of proline, as indicated in Figure 10.

At each proline residue there is a -C-N- linkage which constitutes part of the main chain but about which there cannot be free rotation since this linkage is also part of a five-membered ring. If a segament of a polypeptide chain is in its most extended form, and if this segment includes the -C-N- bond of proline, it is to be noted, as shown in Figure 10, that the succeeding -N-C- bond is deviated markedly from the plane containing the main chain bonds of the other residues. It follows that an extended polypeptide chain such as found in silk or stretched wool is not possible for collagen. For a polypeptide chain, in which proline occurs at frequent intervals, to repeat itself regularly and continue along a generally straight line, it must take some folded form[5] or spiral form[6] in which each amino acid residue projects 2.9 Å on the fiber axis. Because of the restrictions imposed by the proline residues an average projection of 2.9 Å per residue also represents a collagen molecule at near maximum extension. Hence, it is not surprising that stretching collagen does not change the fiber repeat period. Neither would we expect oriented col-

lagen to exhibit long range elasticity similar to that shown by wool. Any elongation on stressing must result from the straightening out of kinked chains or from slippage of chains in the amorphous portions of the fiber.

Collagen swells much more in water than either wool or silk, absorbing roughly six times as much water as wool and nine times as much water as silk. It might be expected that the hydrophilic character of a protein is related to the number of polar side groups along the polypeptide chain, but in this respect collagen and wool are not greatly different; the much lower swelling of wool must then be due to some difference in the structural organization of the fiber which resists chain separation. The cystine cross-linkages occurring between adjacent chains every tenth amino-acid residue in wool would serve this function by tying the chains together in a reticular structure which effectively resists swelling. Collagen contains only minor amounts of cystine, less than 0.2 per cent, and primary cross-linking of this kind must be infrequent. In this connection it is interesting that while collagen swells considerably in water relative to wool or silk, this swelling is still definitely limited by the structure. If the collagen molecules are somewhat degraded, as in the formation of gelatin, a water-soluble product results, even though the molecular weight may be 100,000. Whether the limited swelling of collagen is due to the presence of a few linkages between adjacent chains or to its high molecular weight cannot be stated. Even so, native collagen is ordinarily chemically treated to reduce its hydrophilic character, and this is a principal object in the tanning operation.

Thus far we have spoken only of short-range periodicity—5 or 10 Angstrom units—assignable to lateral separation and to recurrence of short loops in threadlike molecules, and to regular repetition of amino-acid residues in a polypeptide. Keratin,[7] silk,[8] and collagen all show a further, long-range periodicity, not yet satisfactorily explained. The fundamental spacing in collagen is 640 Å and was discovered by its diffraction effects.[9]. It has been revealed also through electron microscopy by Schmitt and his collaborators.[10]

Collagen is easily dispersed into submicroscopic fibrils, characteristically striated transversely. Micrographs of collagen fibrils, made in this Laboratory during an electron microscopic study of the effects of leather manufacturing procedures on collagen primary structures, are reproduced as Figures 11 and 12. Figure 11 shows a group of fibrils at magnification 30,000 X. The three-dimensional aspect arises in shadows cast by oblique deposition of gold upon the specimen. The uniform repeat distance of 640 Å is evident, and it is clear that the striated appearance is due to a succession of duplex ridges separated by shadowed depressions along the fibril. Long-range periodicity is displayed further resolved in Figure 12, in which the magnification is 200,000 X. Two fibrils of opposite polarity are shown in close lateral association. Each fibril is only about 800 Å across. The larger intervals drawn at the right mark off the 640 Å period, and shorter lines are directed toward six sub-units. These are not equally spaced.

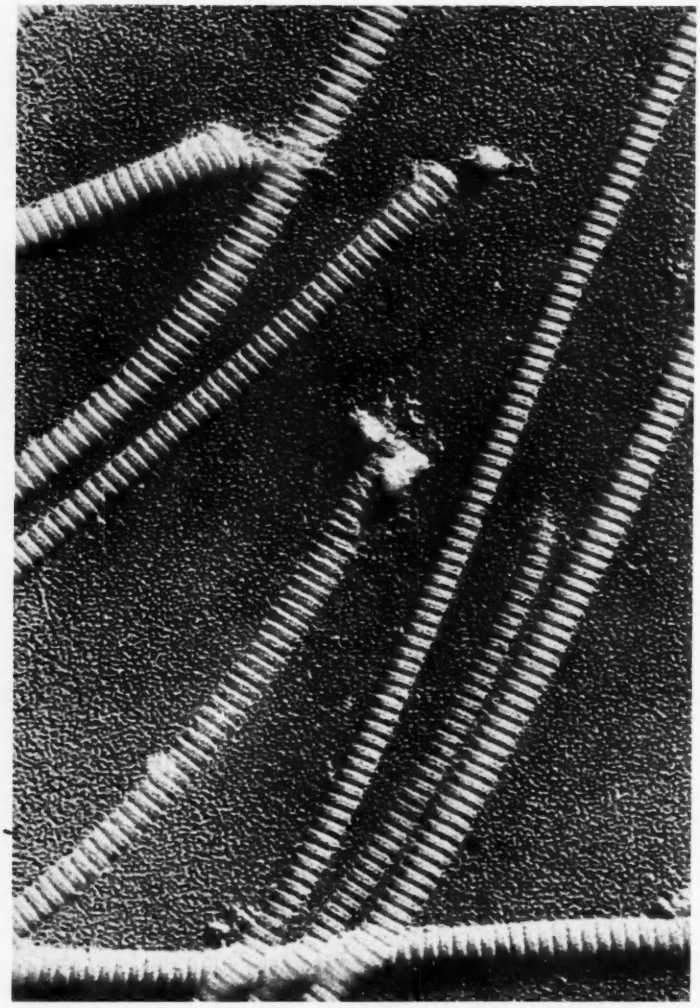


Figure 11. Electron micrograph of cowhide collagen fibrils shadowed with gold. Magnification 30,000 X.

No collagen model consonant with all the observations of diffraction and electron microscopy has been proposed.

Artificial Protein Fibers

We may now turn to a discussion of the structure and properties of the artificial protein fibers. The first consideration is to establish whether globular protein molecules, like those of casein, zein, soybean protein, can be unfolded into extended polypeptide chains. Unfolding has been demonstrated[11] with a dozen globular proteins, and it appears that true fibers can be made from these proteins, i.e., fibering on a molecular scale can be realized. Primary evidence for the conversion from the globular to the fibrous state rests on X-ray diffraction diagrams. Figure 13 shows the pattern produced by

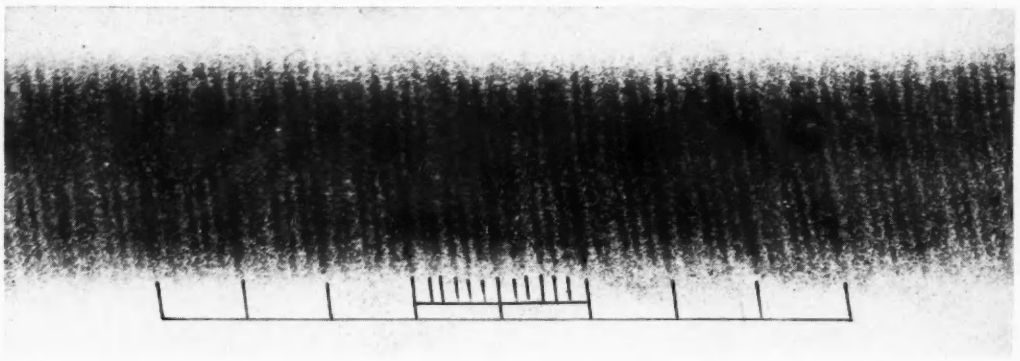


Figure 12. Electron micrograph of cowhide collogen fibrils stained with phospho-tungstic acid. Magnification 200,000 X.

an ovalbumin fiber in which the molecules are largely in the globular form; Figure 14, the pattern after conversion to the fibrous state but without any preferential alignment of the molecular chains; and Figure 15, the same fiber after stretching to orient the chains in the direction of the fiber axis. Marked changes in tensile strength accompany the conversion to the fibrous state. The fiber giving the diffraction pattern of Figure 13 was so weak the brittle that accurate measurement of its strength was impracticable; after conversion to the fibrous state it became pliable and had a strength of about 0.4 gram per denier; upon orientation to give a pattern like that of Figure 15, its strength increased to about 2 grams per denier.

At this point it may be of interest to inquire which of the natural fibers, silk, collagen or wool, we should expect fibers from proteins such as casein, ovalbumin, soybean protein or zein to resemble most closely. From the viewpoint of composition, i.e., the bulkiness and polar nature of a high proportion of the side chains, and the low proline content, we might predict that the polypeptide chains of these proteins will pack more like wool than either silk or collagen. This is, in fact, observed experimentally, for the X-ray pattern of the artificial protein fiber of Figure 15 is practically identical with that of stretched wool (β-keratin). In this connection it should be mentioned that none of the artificial protein fibers have given an α-keratin pattern.

Load-Elongation Data

We may investigate further and compare the tensile properties of artificial protein fibers with those of the natural fibers. For this purpose load-elongation diagrams[12] of ovalbumin, horsehair, collagen and silk fibers are presented in Figures 16, 17 and 18. Horsehair and wool are much alike in composition and mechanical behavior, but because of their larger size, horsehair filaments are more convenient to work with. An important variable in any fiber is the degree of orientation of the crystallites or molecular chains along the fiber axis. This is controlled by the amount of stretch given the fiber after it has been formed. In Figure 16, this is designated by the relative length (R.L.) of the fiber—the ratio of length after stretching to the original lengh. R.L. = 1 designates an unstretched ovalbumin fiber which gives an X-ray pattern corresponding to Figure 13. It is not surprising that this fiber possesses low tensile strength in view of its low orientation; indeed, the orientation is such that the fiber does not withstand stress sufficient to straighten the chains in the less-ordered regions and thus permit elon- the R.L., and thereby the orientation, of the fiber increases, both the elongation and the strengh improve. The elongation passes through a maximum of about R.L. = 2, reaching a value of 35 per cent. Highly oriented fibers represented by R.L. = 6.5 show high strength but lower extensions-at-break; most of the kinks and

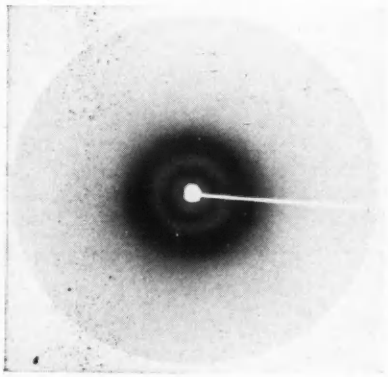


Figure 13. Diffraction pattern of an ovalbumin fiber in which the molecules are largely in the globular form.

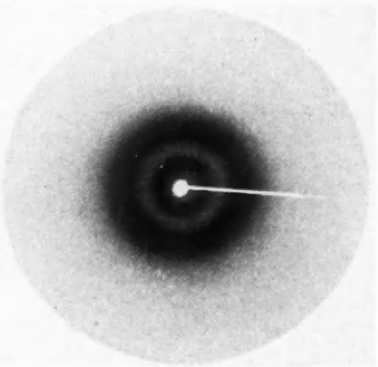


Figure 14. Diffraction pattern of an ovalbumin fiber in which the molecules are unfolded but not oriented.

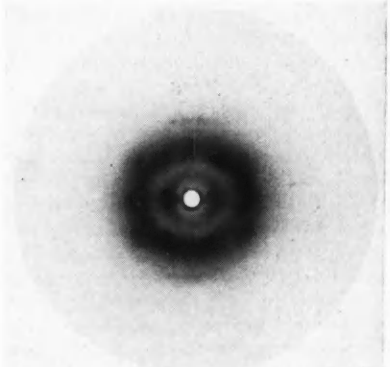


Figure 15. Diffraction pattern of stretched ovalbumin, β-keratin structure.

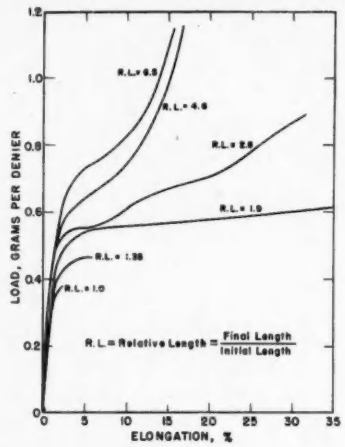


Figure 16. Load-elongation curves of ovalbumin fibers.

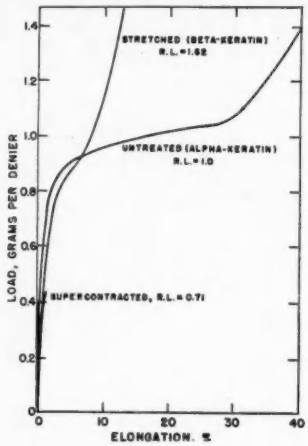


Figure 17. Load-elongation curves of horsehair.

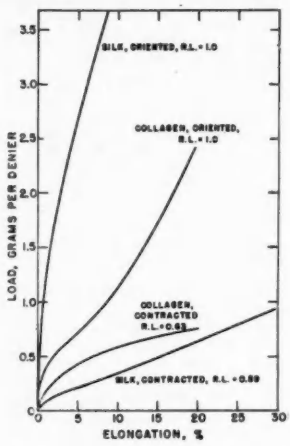

LOAD, GRAMS PER DENIER
ELONGATION, %
SILK, ORIENTED, R.L. = 1.0
COLLAGEN, ORIENTED, R.L. = 1.0
COLLAGEN, CONTRACTED R.L. = 0.63
SILK, CONTRACTED, R.L. = 0.89

Figure 18. Load-elongation curves of silk and collagen.

the folds were taken out of the molecules in the orientation process.

With increase in relative length beyond R.L. = 1.35, there is a decrease in flexibility, as measured by the knot strength of the fiber or by the ratio of the knot strength to the straight-pull tensile strength. This effect, which is also shown by stretched horsehair, may be a property of the oriented β-keratin structure, or it may be associated with a low effective chain length, since silk which possesses a similar structure retains high flexibility.

Data on horsehair, a typical keratin, are presented in Figure 17. In this case we have three states of orientation: untreated horsehair in the folded α-keratin structure, stretched horsehair in the β-keratin configuration giving an X-ray pattern comparable to highly oriented ovalbumin fibers, and "supercontracted" horsehair giving an X-ray pattern much like that of ovalbumin of R.L = 1—orientation has been destroyed by allowing stretched horsehair to contract to about 30% of its initial unstretched length in boiling buffer solution of pH 8. The stress-strain diagrams corresponding to supercontracted and stretched horsehair roughly parallel the diagrams of ovalbumin with R.L. = 1 and R.L. = 6,5, respectively. Ovalbumin of R.L. = 3 most closely resembles normal horsehair in its stress-strain behavior; horsehair elongates at the expense of the folded structures in both the disorganized and organized regions while in ovalbumin fibers only the disorganized regions can contribute. Both fibers show regions of low modulus associated with chain unfolding, and probably chain slippage, followed by a region of higher modulus associated with increased molecular orientation in the disorganized regions.

Both silk and collagen likewise show considerable dependence in their tensile properties upon the degree of orientation, as shown by the stress-strain curves given in Figure 18. The silk and collagen used in these experiments were suture material and were obtained as highly oriented fibers. R.L. = 1 refers to this oriented state. A lower state of orientation was induced in silk by contraction in 8.42 M HCl at room temperature, and in collagen by contraction in water at 70° C. Oriented collagen has a stress-strain curve of the same general form as highly oriented ovalbumin and horsehair, but has a much higher ultimate strength. Contraction of collagen results in a much lower tenacity, but not in the increased elongation which might be expected from a folded structure. Evidently the weakening effect of disorientation permits the fiber to break before the molecules are fully extended. This effect is even more pronounced in supercontracted horsehair.

Oriented silk, the normal form of silk, differs in its stress-strain behavior in that it shows no well-defined break in its curve. The relatively higher lateral forces between chains resulting from their close lateral packing is reflected in the steep slope of the stress-strain curve at low elongations. That is, a greater force is required to extend silk than is required by a keratin or ovalbumin fiber of the same diameter—silk is a stiffer fiber. Contraction of the silk by acids disorients the crystallites greatly, as demonstrated by the diffraction pattern, but the crystallinity is not destroyed to the degree that it is in contracted collagen or supercontracted horsehair. The disorientation and disordering result in a softer fiber with increased elongation.

Although the ultimate strength and elongation and the shape of the entire stress-srain curve are imporant considerations in any textile fiber many of the properties of a fabric must be determined by the behavior of its fiber at low elongations, for in a fabric the elongation of the individual filaments is never great. Ray[15] has developed this idea and has compared the elastic properties of several fibers at one and two per cent extension. Some of his data are reproduced in Table 1. In addition to the elastic modulus, the rigidity modulus, or the resistance of the fiber toward deformation by torsion, is given. It is to be noted that while all the fibers have nearly the same resistance to twisting, they differ widely in their elastic modulus. They also differ in the amount of work expended in stretching the fiber, which is recovered when the stress is removed. This property is related to the resilience of the fiber, and wool is exceptional among the natural fibers in this

TABLE 1*

Fiber	Rigidity Modulus G (dynes/cm.²)	Elastic Modulus E (dynes/cm.²)	E/G	Work Recovery at Elongation of 1%	2%
Wool	1.7 x 10¹⁰	3.4 x 10¹⁰	2.0	95%	90%
Casein	1.3	2.9	2.2	92	65
Silk	1.2	13.9	11.5	75	45
Cellulose	1.4	5.0	3.5	50	20
Cellulose, high tenacity	1.6	17.1	10.5	..	..

* L. G. Ray, Jr., Textile Research Journal *17*, 1 (1947).

respect. Casein bears a remarkable resemblance to wool in moduli as well as work recovery, showing that it is more wool-like than silk-like in its elastic properties at low elongations. At higher elongation casein and ovalbumin recover less completely both in respect to length and work than does wool or silk.

So far we have considered the tensile properties of fibers at water contents corresponding to standard testing conditions (65% R.H. and 70° F.). In the wet state, the artificial protein fibers lose considerable strength and are in marked contrast to wool and silk in this respect. It has already been stated that the high wet strength of wool depends largely on the presence of primary bonds between chains formed by cystine linkages. In silk, the high proportion of crystalline regions provide anchor points along the polypeptide chains maintaining the strength of the fiber in the wet condition. The crystallinity of the artificial protein fibers produced so far is insufficient to confer adequate wet strength, and it has been necessary to employ various "hardening" treatments, such as reaction of the fibers with formaldehyde or quinone, to stabilize the fibers through the formation of cross-linkages between chains. It is noteworthy, however, that ovalbumin fibers giving X-ray patterns like Figure 13 have wet strength that is half the dry strength without any hardening treatment. Casein fibers are much lower on the crystallinity scale and attain appreciable wet strengths only after hardening.

* * *

I should like to express my appreciation to G. C. Nutting and R. Barasky for the electron micrographs used in this paper.

References

[1] E. F. Mellon, A. H. Korn and S. R. Hoover, unpublished data.
[2] W. T. Astbury and A. Street, Trans. Roy Soc. A*230*, 5 (1931).
[3] H. B. Bull, J. Am. Chem. Soc. *67*, 533 (1945); J. H. Woods, J. Coll. Sci. *1*, 407 (1946).
[4] M. Harris, L. R. Mizell and L. Fourt, J. Res. Nat. Bur. Stds. *29*, 73 (1942).
[5] W. T. Astbury, J. Intern. Soc. Leather Trades Chem. *24*, 69 (1940).
[6] M. L. Huggins, Chem. Rev. *23*, 195 (1943).
[7] I. MacArthur, Nature *152*, 38 (1943).
[8] H. Friedrich-Freska, O. Kratky and A. Sekara, Naturwiss. *32*, 78 (1944).
[9] R. S. Bear, J. Am. Chem. Soc. *66*, 1297 (1944).
[10] F. O. Schmitt, C. E. Hall and M. A. Jakus, J. Cell and Comp. Physiol. *20*, 11 (1942); F. O. Schmitt, The Harvey Lectures, Series XL, p 249 (1945).
[11] F. R. Senti, M. J. Copley and G. C. Nutting, J. Phys. Chem. *49*, 192 (1945).
[12] G. C. Nutting, M. Halwer, M. J. Copley and F. R. Senti, Textile Res. J. *16*, 599 (1946).
[13] L. G. Ray, Jr., Textile Res. J. *17*, 1 (1947).

Membership Applications

JUNIOR

Grace R. Wildermuth—Text. Technologist, Virginia-Carolina Chem. Corp., Carteret, N. J. Sponsors: J. W. Bordner, W. P. Ter Horst.

ASSOCIATE

Arthur M. Butler—Asst. Secretary and Treas., Faith Mills, Inc., Averill Park, New York.

Simon Levin—Owner and Partner, Park Royal Dye Works, New York, N. Y.

Martin C. Powers—N. E. Editor, Cotton Mills Information Service, New York, N. Y.

Helen A. Wellington—Research Associate in Textiles, University of Alabama, University, Ala.

STUDENTS

Bernard Sugarman—Philadelphia Textile Institute. Sponsor: P. Theel.

Wesley M. Gardner—Bradford Durfee Technical Institute. Sponsor: L. B. Coombs.

Applications for Transfer to Senior Membership

Paul S. Buffington, Harold W. Berry.

Spring Meeting, Piedmont Section

THE Spring Meeting of the Piedmont Section of the A.A.T.C.C. was held in Greensboro, N. C., at the O'Henry Hotel, April 12, 1947.

The meeting was opened at an afternoon technical session with M. C. Welker of the Ion Exchange Resin Division of the American Cyanamid Co., New York, as the speaker. He used as his subject "The Use of Ion Exchange Resins for Demineralizing Water." Mr. Welker gave a very interesting description of the use of Ion resins in demineralizing water, showing slides of these reactions, along with dyed samples showing improved dyeing qualities. Also tests were made showing better solubility of colors in demineralized water. A miniature Ion Exchange Unit was on display for demonstration purposes.

A banquet session was held at 7:30 p.m. with W. D. Carmichael, controller and business manager of the Greater University of North Carolina, as speaker. Mr. Carmichael gave about twenty minutes of wit and humor followed by compliments to the Piedmont Section for the fine work it was doing for industry in this section. He gave some details of the textile expansion plans at N. C. State College and solicited our aid and support in making the Textile School of State College better fitted to serve the Textile Industry of the South.

R. A. Bruce of Greensboro was in charge of golf arrangements, and Hobart Souther of Greensboro was in charge of the entertainment.

W. W. Gluyas of High Point was Chairman of the meeting.

Chairman Wyss L. Barker announced the appointment of a Research Committee from the Piedmont Section. This committee will handle sectional papers for the National Meetings and also cooperate with the National Research Committee in any way possible. Mr. Barker also announced that the Sectional Paper for the National Meeting in Chicago was well in hand. Dr. Raphael E. Rupp of Lyman, S. C., was appointed chairman of this committee with Charles B. Ordway of Greensboro, N. C. and V. B. Holland of Kannapolis, N. C., as members.

Several announcements were made regarding the Piedmont Section's Summer Outing at Myrtle Beach, S. C., June 20th and 21st, 1947.

Approximately 250 people attended the meeting and banquet.

Respectfully submitted,

R. H. SMITH,
Secretary.

CALENDAR

EXECUTIVE COMMITTEE ON RESEARCH
Meetings: May 1 (Lowell, Mass.); June 4 (New York).

COUNCIL
Meeting: June 6 (New York).

RESEARCH COMMITTEE
Meeting: June 6 (New York).

NEW YORK SECTION
Outing: June 20. (North Jersey Country Club).

PHILADELPHIA SECTION
Meeting: May 23.
Outing: June 13. (Atlantic City Country Club).

NORTHERN NEW ENGLAND SECTION
Meetings: May 16, September 26, November 21.
Outing: June 13.

PIEDMONT SECTION
Outing: June 20 and 21. (Ocean Forest Hotel. Myrtle Beach, S. C.)

MID-WEST SECTION
Outing: June 21 (Lake Lawn, Delavan, Wis.)

SOUTHEASTERN SECTION
Meeting: June 7. (Atlanta, Ga.)

NATIONAL CONVENTION
October 23, 24, 25. (Congress Hotel, Chicago, Ill.)

Metachrome Dyeing — Part II *

Minimizing the Adverse Effect of Iron on Fastness of Chrome Colors Through Use of the Metachrome Method of Dyeing

CHARLES H. A. SCHMITT

Sandoz Chemical Works, Inc.

IT is common knowledge that the presence of excess amounts of iron, either in the water or in the dyeing equipment, causes various degrees of shade damage in a majority of chrome colors. This knowledge is shared by both the manufacturers of dyestuffs as well as by the dyers who have to use them. For many years, the common procedure was to offset the change in shade through proper shading with other colors and in the earlier days of dyeing it has been reported that some dyers put a block of zinc in the bottom of the kettle. Chrome dyes are more affected by iron than acid dyes because they form iron lakes very easily and as is well known this is especially true when dyeing is carried out by the after chrome method.

In more recent years and particularly with the advent of the modern neutral metachrome dyeing color, this damaging effect on shade can be quite easily overcome by dyeing by the metachrome method. The work of this author and my associates confirms findings by other workers here in this country as well as in England, that chrome dyes when applied by the metachrome method are less susceptible to the effects of iron.

[To illustrate the superior resistance of chrome colors to iron, dyed metachrome, as compared with the result obtained top-chrome, a few Kodachrome slides of tests illustrating these differences on a number of chrome colors were shown. Slides No. 1 and 2 showed the effect of iron and copper on the shade of chrome colors when dyed top-chrome, and their resistance to dulling effect when dyed metachrome.]

As mentioned previously, the effect of iron on shade, and the possible minimizing of this by dyeing metachrome has been well recognized, but there has been little or no emphasis, or information published as far as we know, on the importance *this shade change has on the fastness of these same chrome dyestuffs.* In the study we have been conducting, we have made an attempt, and hope to show you this evening, that wherever shade damage takes place by the presence of iron, there is also a degree of degradation in fastness of the dyestuffs. We have not been able to carry out tests of all mill and wearing requirements, but have conducted sufficient tests on fastness to light, fulling, decatizing and carbonizing, to form an opinion on this matter. In work done by this author many years ago we also noted that iron damage to the shade of chrome colors also had a serious affect on fastness to perspiration. Time has not permitted a review of this condition at this time.

We hope to show in the following study and through colored photographs of our work, that many times irregularities along the line of production in the mill have stemmed from what took place in the dye kettle and fundamentally through no fault of the dyer. In finding the shade not coming up to expectations, it quite often is necessary to shade with certain fast, acid or alizarine colors to reach the proper shade. The basic reason for failure to come up to shade is that certain chrome colors in the combination have been dulled or changed sufficiently in shade by the presence of iron, as to require this additional shading, and as you all well know, the acid and alizarine colors generally show good resistance to dulling by iron. The result of all this is that the goods leave the dyehouse absolutely on shade, but during carbonizing, fulling or decatizing, the chrome colors in the combination which have been affected by iron, will be seriously damaged in the various finishing treatments, and result in off shade goods at the perch.

Our investigation confirms that top-chrome dyeing permits the greatest possible shade damage by iron. At this point we might recommend that where you use Glauber's salt in your top-chrome dyeing, it is a good point to check on iron content of the Glauber's salt. We particularly remember a great many years ago the difficulty we had in obtaining the proper shade of a grey dyed top-chrome in that it always came up very much on the brown side. When dyed chrome-bottom where no Glauber's salt was used the shade developed perfectly. When checking into this we found that the trouble was coming from the high iron content of the Glauber's salt and when the same top-chrome dyeing was repeated without Glauber's salt in the bath, the damaging effect was eliminated. Today our Glauber's salt is reasonably free of iron.

Influence of pF on Iron Effect

One of the reasons why top-chrome dyeing causes greater dulling and sometimes actual destruction by iron is because most top-chrome dyeing is done at a lower pH ranging from 4½-6 (depending on dyes used) whereas in Metachrome dyeing with *proper* Metachrome dyes the pH of the bath ranges between 6 and 8. We agree that lower pH aggravates the condition in top-chrome work but is not the prime cause. A dyestuff is either good or poor to iron, and if poor, will be so even if dyed neutral as we will illustrate later.

As a matter of interest, in the question of pH we will show in the next slide how lower pH does aggravate the dulling effect on chrome dyes.

[*Slide No. 3, Metomega Chrome Green BLL* was shown at this point*]

Here as in all of the work to follow we used .05% ferrous sulfate figured on the weight of the goods, and distilled water. This was to eliminate errors which would arise due to the irregular iron content of tap water and the various degrees of iron content through the use of nails or washers.

In the work done by Bird & Molloy[1] regarding the dulling effect of chrome dyes by iron, they followed a similar procedure of using ferrous sulfate for similar reasons as just mentioned. .05% ferrous sulfate based on the weight of the cloth and the amount of water used in our dyeings is the equivalent of 2 parts ac-

* Presented at meeting, Rhode Island Section, January 24, 1947. The other paper on Metachrome Dyeing was presented by Mr. Schmitt at the Northern New England Section meeting on April 7, 1939 and published in the American Dyestuff Reporter 1939: 28 336.

tual Fe per million parts of water.

In this slide we only show the effect of iron in top-chrome dyeings made under different conditions.

Formula A.

1% Ammonia 28°)
1% Acetic Acid 56%) Boil ½ hour
add 1% Acetic Acid 56% Boil ½ hour
add ½% Sod. Bichromate Boil ¾ hour

Formula B

2% Ammonia Sulfate Boil ½ hour
add 1% Acetic Acid 56% Boil ½ hour
add ½% Sod. Bichromate Boil ¾ hour

Formula C

1% Acetic Acid 56% Boil ½ hour
add 1% Acetic Acid 56% Boil ½ hour
add ½% Sod. Bichromate

You can see that the normal shade, i.e., without iron, is already damaged by iron in the first part of the dyeing period with ammonia and acetic acid. On adding acetic acid and lowering of the pH, a slight further change takes place—most of the damage having already taken place in the first ½ hour. On chroming, the true shade does not develop due to part of the dye having formed a dull iron lake in the early stages of the dyeing, resulting in a grey instead of a green.

The dyeings started with ammonium sulfate show greater destruction because of the absorption of sulfuric acid by the fabric as the temperature rises under which conditions the formation of the iron lake is easier, (a brown shade) and resulted in complete destruction, giving a brownish-gray shade on chroming.

The dyeings started with acetic acid showed maximum shade damage right from the beginning and resulted in a brown shade on chroming. It might be well to show you at this point how true the shade would have been if the color was dyed metachrome in the presence of iron, but we would, for the sake of order, continue with the basic causes of shade change.

Use of Phosphates in Top-Chrome Dyeing

While we are on the subject of pH and the effect of acids on iron sensitivity, we would like to briefly discuss the possibilities of overcoming these dulling effects in top-chrome dyeing by the use of phosphates.

Many years ago we carried out experiments and found certain chrome dyes, dyed top-chrome were made less sensitive to iron by the use of Calgon and other types of phosphates. On the other hand we found many which were not helped and some actually failed to develop their true shade and chrome properly.

We believe that very small amounts of iron can be sequestered by the use of various phosphates but concur with the opinions of Bird & Molloy[2]—"provided the degree of dulling does not exceed two parts Fe per 1,000,000." They further went on to say—"that when larger amounts of iron are dissolved, the dulling can be greatly reduced by dyeing by the metachrome method."

However, from the work we have done in regard to the relation of iron sensitivity to fastness, we believe and hope to show you that, regardless of the degree of iron content which is so variable, the use of chromates or the metachrome method is the simplest and most effective way of overcoming these conditions. Various workers have also observed that—"the presence of chromate favors the passivity of iron."

Over a period of years we have made sufficient tests to know that if a color is sensitive to iron, damage will take place even in a neutral bath. A single test for the effect of iron on a color is to add a 1% solution of ferrous sulfate to the dye solution. A violent change of color generally indicates a change in the dyed shade. The color of the solution develops, then acts pretty much like an acid color, and if sufficient ferrous sulfate is added, will completely prevent chroming over later. A series of tests are made to illustrate this point. Dyeings were made on Omega Chrome Brown VR which is very sensitive to iron. Tests were made in distilled water with 1% color, dyed as follows:

[*Slide No. 4, Omega Chrome Brown VR (Pr. 2) was shown at this point.*]

1. 3% Acetate Ammonia
2. 5% Acetate Ammonia
3. 2% Ammonium Sulfate
4. 4% Ammonium Sulfate
5. 3% Acetic Acid 56%
6. 5% Acetic Acid 56%
7. 2% Formic Acid
8. 4% Formic Acid
9. 1% Sulphuric Acid
10. 2% Sulphuric Acid
11. No acid or assistants

All boiled 1 hour

These were repeated with .05% ferrous sulfate added to the water before the dissolved dyestuff.

We might mention at this time that this may seem like a small amount of iron, but as you will see from the various photographs to follow that this is sufficient to cause considerable shade change on many chrome dyestuffs.

We have confirmed the findings of Bird & Molloy who found that 4/10 parts Fe per million of water were sufficient to dull the shade of chrome colors while one part would completely alter the shade. Many mill chemists have found that one part Fe per million is the danger point for many of the chrome dyes they use. At this point we would like to go on record against the common practice of chemists using iron nails in a beaker for testing the sensitiveness of a chrome color to iron. In our work we found that one wrought iron flooring nail gave slightly more damage than .05% ferrous sulfate on some chrome colors. Where a mill's iron content runs less than one part per million the use of an iron nail would rule out many dyestuffs for them. If the iron content is known to be .5 or 1.0 Fe per million, we believe it is much better to use a proportionate amount of ferrous sulfate to learn the proper degree of damage that could be expected by the dyehouse water of the dyestuff in question. We also wish to state that many plants who test their water regularly were consulted on the iron content of their dyehouse water. These varied from .3 parts up to 4.9 parts. However, in some mills it runs as high as 10 parts per million at certain times of the year. We should like to add at this point that similar observations and results as we will point out, were obtained when using ferric salts instead of the ferrous.

As for the dyeings made with iron, methods No. 1-10 (with acid present) produced a very yellowish brown in comparison to the wine shade produced without iron. There was little or no difference in the color damage except in the dyeing made with sulfuric acid which was slightly more affected and probably due more to greater exhaustion and surface dyeing. As for the dyeing made with and without iron, dyed neutral—exhaustion was naturally not good with this color, but the same degree of damage took place as in those with acid, which bears out our previous remarks that the damage takes place between the iron and color in the water solution, and the question of pH or acid concentration is of little importance, once a color has been found sensitive to iron.

[*Slide No. 5 was shown at this point.*]

Iron Effect Even Takes Place in Neutral Bath

At this point we want to again emphasize that shade damage by iron comes about through the formation of a new compound between the dye in water solution and the iron, and takes place even in a neutral bath as shown on this colored slide.

In this slide we show three well known chrome dyes:—

Omega Chrome Red B—C.I. No. 652
Omega Chrome Dark Violet D—C.I. No. 169

Omega Chrome Brown VR—Pr. No. 2 dyed in distilled water without dyeing assistants of any kind. In each case the dyeings were made straight, one with one iron nail, and the other with .05% ferrous sulfate on the weight of the goods. With iron present, the Chrome Red dyes a dirty tan instead of a peach shade;—the Violet a red brown instead of old rose; and the Brown VR dyes brown instead of reddish violet. On chroming, all three of these colors fail to develop and are very much browner than they would have been if free from iron or if they had been dyed metachrome. The formation of the new compound occurs more readily when the iron is in a soluble form in the water. However, you are all acquainted with the damaging effect which comes about through the presence of iron fittings, iron bottoms in the kettles, or kettles made entirely of iron. One of the greatest sources of iron in some mills is from the steam pipes in the kettles, especially those running on exhaust steam. Iron conditions in the steam lines are usually bad on Monday or after any extended lack of use.

During the course of this study we have found that the greatest advantages from the fastness standpoint coming from metachrome dyeing, are confined to dyes that are sensitive to iron. We have also confirmed our previous findings that there is danger in using too little chrome or metachrome mordant both from the standpoint of shade development as well as fastness properties.

In the next slide we have combined the tests in such a way so that we can show:

1. The difference in shade development between small and proper amounts of metachrome mordant in metachrome dyeing, or in the amount of bi-chrome in top-chrome dyeing.
2. The effects of iron on the shade made with too little chrome or metachrome as compared with proper amounts.
3. In this same slide we show how the amounts of chrome and the method can influence the fastness to carbonizing with or without the presence of iron.

As previously mentioned, all tests were made with distilled water. As the use of iron nails or washers is so unreliable due to varying degrees of oxidation, we used .05% of ferrous sulfate figured on the weight of the goods.

In this slide series we show dyeings of Metomega Chrome Green BLL*—

[Slide No. 6 was shown at this point.]

1. Dyed Metachrome with 1% Metachrome Mordant.
2. Dyed Metachrome with 3% Metachrome Mordant.
3. Dyed Top-chrome with ½% Bichrome.
4. Dyed Top-chrome with 1% Bichrome.
5. The original dyeings with and without iron are mounted down the center of the card (without iron on left—with iron on right.)

As a matter of record, the formula for the metachrome and top-chrome dyeings are as follows:

Metachrome

1% Metomega Chrome Green GLL*
2% Ammonium Sulfate
Plus 1 or 2% Metachrome Mordant as noted
Dyeings boiled for 1¼ hours.

Top-Chrome

1% Metomega Chrome Green BLL*
10% Glauber's Salt
1% Acetic Acid 56%
1% Ammonia; boiled for 30 minutes
1% Acetic Acid 56% added and boiled 15 minutes
½% of 1% as noted bi-chrome—boiled ¾ hour.

As a matter of interest a series of pH readings were taken of these two standard methods of dyeing (with and without iron). At the start as well as after 30 minutes boiling we found no more than .2 to .3 difference in pH between the two methods.

The dyeings on the right hand side of the photograph contain, as mentioned previously, .05% ferrous sulfate based on the weight of cloth dyed which when figured on the total amount of water used in the dyeings, amounts to 2 parts of actual Fe per million parts water.

Remarks on Shade Development Through Lack of Sufficient Chrome

The first thing we want to point out in this slide is the possible damage in not using sufficient chrome either in top-chrome or metachrome dyeing. While the improvement in shade of 1% chrome over ½% in top-chroming, is not too great you can readily appreciate how dull and undeveloped the shade would be if the bi-chrome was cut to ¼%. In looking at the metachrome dyeings, the better development of the shade as compared with the top-chrome is very noticeable and it is here that we wish to thoroughly emphasize the need of sufficient metachrome mordant. While the tests on this particular color show 1% and 3% metachrome mordant we wish to state now, as will be pointed out later, that 2% is the minimum we recommend. The 3% metachrome mordant was used in this set of tests to make the comparisons with the insufficient or 1% metachrome mordant more obvious. Here, as in the tests to follow, you will see that the proper shade is not always fully developed when using only 1% metachrome mordant with 1% dyestuff.

There are a number of fellow workers who have stressed the use of less chrome than that normally recommended by the dye-makers. This was followed by some dyers during the war, on khaki, with varying degrees of success. We believe this was possible because most of the colors used for OD, such as Alizarine Blue Black B, Flavine A, Brown PG are not sensitive to iron and full chroming action was obtained from every bit of chrome used. However, when you are using chrome colors which are sensitive to iron, and most chrome colors are, it is time to use full and proper amounts of chrome, because part of the chrome will be offset by the presence of iron. We still believe that a minimum of 2% metachrome mordant in metachrome dyeing or ½% chrome for top-chrome should be used on light shades. If you know iron content is low and your colors iron resistant, these amounts could be cut slightly or to 1½% and ⅜% respectively.

Effect of Iron on Shade with Different Amounts of Chrome or Metachrome Mordant

Looking at the right hand side of the slide which shows dyeings containing .05% ferrous sulfate, it is clearly evident that in the top-chrome dyeing, the dyeing with ½% chrome has been materially affected, actually turning to a brownish grey. The dyeing made with 1% chrome is not so badly effected but still fails to come up to the green shade of the dyeing without iron. However, we ask you to take particular note of the dyeing which is above the top-chrome, or the ones dyed metachrome. The top dyeing made with 1% metachrome mordant has dyed a green and is not too far away from the shade of the dyeing made without iron. However, the dyeing with 3% metachrome mordant dyed in the presence of iron shows no shade change whatsoever. We therefore hope that this first series of tests convinces you of the superior resistance to shade damage by iron of colors dyed metachrome as compared with the poor results that one would get dyeing the same products top-chrome.

Relationship of Shade Damage by Iron to Fastness to Carbonizing Dyed Metachrome vs. Top-Chrome

On the left hand side of this slide we

observe better development of the shade metachrome than top-chrome, and a still better development with the higher amounts of metachrome. Starting way over on the left hand side we have the swatches after treatment with 6° Twaddle sulfuric acid and baked. Moving towards the center the next series of swatches show the baked samples after having been rinsed in plain water, with the next swatch after being neutralized with soda. This represents the final stage of the carbonizing treatment which has been mounted directly beside the original pieces for direct comparison. It is very evident that the top-chrome dyeing with only ½% chrome suffered the greatest shade change in the acid and did not return completely to the original shade. The top-chrome dyeing topped with 1% chrome showed less damage in the acid and came back nearer to the original shade. It is now interesting to note how much less damage the metachrome dyeings suffered. The dyeing with 1% metachrome mordant suffered less change in the baking than the top-chrome dyeings, and after rinsing and neutralizing comes back fairly well to the original shade. However, the dyeing made with 3% metachrome suffered little or no change, maintaining its true shade right through rinsing and neutralizing. Here is a very good example of why we recommend dyeing metachrome. Not only do we produce a better developed shade to start with, but undergo little or no change in the carbonizing process.

On the right hand side of the center of the slide we have similar tests made on dyeings which contain .05% ferrous sulfate in the dyebath. Going to the outside of the slide, the dyeing made top-chrome with only ½% chrome has turned to an old-rose shade after the acid immersion and baking. After rinsing it comes back to a taupe shade. Neutralizing with soda ash makes no improvement with the result that there is a wide difference in its shade as compared with what it was at the start. The dyeing at the bottom topped with 1% chrome suffers almost the same fate, turning to a dull red violet and never coming back to the original shade. In these two cases the small amount of iron completely prevented the development of the green. You can well imagine the difficulty that would be encountered in the mill if a small amount of this green or a similar green sensitive to iron was used along with other colors which were not affected by iron, and by the time it had come through the carbonizing process there would have been a very big change of shade due to the destruction of the green in the carbonizing.

At the upper right we show the result of this color dyed metachrome in the presence of the same amount of iron. As pointed out earlier there is little or no effect of the iron on the shade. Even the dyeing with only 1% metachrome which we do not consider sufficient, has only undergone a slight change in the acid and comes back quite well towards the original shade. The dyeing made with 3% metachrome mordant undergoes even less change in the acid, returning to the proper shade with just plain rinsing in water. We believe this exhibit definitely shows the colors sensitive to iron have better fastness to carbonizing if dyed metachrome. To put it in another way, those dyestuffs which seem to be very sensitive to iron dyed top-chrome show considerable damage of shade in carbonizing, but when dyed metachrome with sufficient metachrome mordant, develop their proper shade and maintain it through the carbonizing treatment.

We will now follow up with a series of colored slides showing a number of Metomega Chrome Colors as well as a number of ordinary chrome colors dyed with 1% and 2% metachrome on 1% of dyestuff, against a top-chrome dyeing with ½% chrome. These are likewise dyed with and without ferrous sulfate, after which they were put through the carbonizing tests such as just shown you on Metomega Chrome Green BLL.

[*Slide No. 7, Omega Chrome Red B (C.I. 652)—Carbonizing Tests, was shown at this point.*]

Here are the carbonizing tests of the series on Omega Chrome Red B. Even though the metachrome dyeings look pretty good, we believe you all know that it is not as satisfactory on worsted top, yarn and paricularly on raw stock. However, we have used it to illustrate the point we are trying to make, that where colors are badly damaged in shade by iron when dyed top-chrome they also undergo terrific change in carbonizing. From the great number of tests we have made, we find that if the color will dye metachrome it is far better to do so because the shade will be maintained in the presence of iron and will be further maintained through the carbonizing process. Here in the case of Omega Chrome Red B the top-chrome dyeing in the presence of iron comes out as a pale rust shade and goes through a serious change towards the orange in baking, and only coming part way back to the original dull shade. Dyed metachrome the color seems to be perfectly fast to carbonizing when dyed in the presence of iron.

[*Slide No. 8, Metomega Chrome Red GM*-Carbonizing Tests, was shown at this point.*]

Here is a similar set of carbonizing tests of Metomega Chrome Red GM. As in the case of Omega Chrome Red B and Green BLL, iron shows no damage to the shade when dyed metachrome. On the other hand, dyed top-chrome in the presence of iron, the shade is ruined. Likewise when subjected to carbonizing the color is badly affected top-chrome but stands up exceptionally well dyed metachrome. Here, as in the case of Red B and Green BLL there is practically no difference in the fastness of the color to carbonizing dyed in the presence of iron or without.

[*Slide No. 9, Metomega Chrome Brown 3GL*-Carbonizing Tests, was shown at this point.*]

In this slide we see another proof that when there is a serious iron condition in the water, shade damage can be eliminated by dyeing metachrome. Likewise, when dyeing is carried out top-chrome with such an iron condition, carbonizing fastness is materially reduced, and by dyeing metachrome the trouble overcome and excellent fastness to carbonizing obtained.

Relation of Shade Damage by Iron to Fastness to Fulling, Dyed Metachrome vs. Top-chrome

The series were also put through a 3 hour fulling test. As regards this question of fastness to fulling, we did notice many of the colors when dyed top-chrome in the presence of iron suffered badly in shade after fulling. There was another change in shade which in our opinion could many times be a contributing factor towards causing off-shade pieces at the perch. In other words, after the dyer has matched and passed the shade in spite of damage to a particular chrome color in this combination, the fulling changes the shade of the sensitive color in the combination enough to give quite a different result at the perch.

[*Slide No. 10, Omega Chrome Red B (C.I. 652) was shown at this point.*]

Here we have 3 hour fulling tests of the two metachrome dyeings against the top-chrome and the same tests conducted in the presence of iron. As mentioned before the shade having been ruined in the top-chrome dyeing with iron, changes shade again in the fulling. This is not too evident here in the photograph, but in the actual tests it is very noticeable. However, the matter of staining of white fibers does not seem to have been altered in any way.

[*Slide No. 11, Metomega Chrome Red GM*-Fulling Tests, was shown at this point.*]

Again we show that the presence of iron in the metachrome dyeing causes no ill effect on the fastness to fulling of this color. However, when dyed top-chrome, we have an excellent example of what

happens every day in the mill, in that the pieces after fulling do not always have the same shade as they did beforehand. Here at the bottom right are top-chrome dyeings in the presence of iron, which have produced a light brown. After fulling part of the brown shade disappears giving somewhat near the proper red shade of a top-chrome dyeing made without iron. It appears that the brown iron lake which was formed during the dyeing has been removed by the fulling, leaving a true red chrome lake in evidence.

You can well appreciate that if a dyer was not developing the proper redness of his shade when using this color top-chrome (with iron present) he would find it necessary to add some other red such as a Sulfonine or a Milling red. After fulling a very substantial change would result in that he would have twice the redness in his finished goods than he anticipated because this orange shade of chrome red would develop redder, in addition to the milling color which did not undergo any shade change.

[*Slide No. 12, Metomega Chrome Brown 3GL*—Relation of Shade Damage by Iron to the Fastness to Light of Dyestuffs dyed Metachrome vs. Top-chrome, was shown at this point.*]

[*Slide No. 13, Metomega Chrome Green BLL*, was shown at this point.*]

On this slide we show 40 and 50 hour Fadeometer tests of a series of dyeings on Metomega Chrome Green BLL. These were dyed with 1% as well as 3% metachrome mordant with and without .05% ferrous sulfate. Also included are similar tests of top-chrome dyeings using ½% as well as 1% bi-chrome dyed with and without iron. It is very evident here that 1% metachrome mordant does not develop the shade fully and the light fastness is inferior to the dyeing dyed metachrome with 3% metachrome mordant. The difference in shade development of 1% chrome over ½% chrome in top-chrome dyeing is not too evident and the difference in light fastness does not seem to be influenced but slightly in favor of the higher percentage of chrome.

Looking at the tests on the upper right hand half of the slide of the dyeings with iron, the same condition exists again in that the metachrome dyeing with the higher percentage of metachrome mordant is definitely faster to light. As for the dyeings dyed in the presence of iron, their light fastness, like many other colors which we have tested under similar conditions show only slight deterioration in light fastness, as compared with dyeings without iron present.

As for the top-chrome dyeings made with iron they have been converted to browns and on exposure show considerably poorer to light than the top-chrome dyeings without iron.

We would again recommend that a minimum of 2% metachrome mordant seems necessary to obtain proper development of the shade along with maximum light fastness. While even lesser amounts of metachrome mordant immunize the damaging shade effect by iron, it is safer to use higher amounts of metachrome mordant to immunize the damaging shade effect by iron, when one knows this condition exists. As far as top-chrome dyeing is concerned, higher amounts of chrome than normally employed (that is half as much chrome as dyes) do not give very much better light fastness, and no immunizing effect on shade damage by iron.

Fourteen chrome colors representing *true metachrome* as well as so-called "all method" colors were dyed with and without iron top-chrome, as well as metachrome with 1% as well as 2% metachrome mordant. Eleven of the 14 dyed top-chrome showed slight to very bad light fastness reduction dyed in the presence of iron. When dyed metachrome with 1% metachrome mordant these same 11 showed better fastness than the top-chrome and still better with 2% metachrome mordant, the latter being but slighly poorer than the dyeings without iron.

The tabulation of this series is given in Table I.

Colors which are badly changed in shade by iron dyed top-chrome show the greatest loss in light fastness, with a noticeable improvement when dyed metachrome with 1% metachrome mordant, and a still better fastness with 2% metachrome mordant. In most cases the dyeings with 2% metachrome mordant show very little, and in some cases, no loss in light fastness as compared to similar dyeings made in the absence of iron.

[*All of the colors included were mounted and placed on exhibition.*]

TABLE I

Affect of Iron on Light Fastness

(Comparisons reported vs. dyeings without Iron)

1%	Dyed with 1% M.C.M. *	Dyed with 2% M.C.M. *	Dyed Top-chrome (½% Chrome)
Omega Chrome Red B (C.I. 652)	Trifle poorer	Trifle poorer	Much poorer
Omega Chrome Bordeaux BL (C.I. 168)	Sl. poorer	Sl. poorer	Consid. poorer
Metomega Chrome Red GM*	Sl. poorer	Sl. poorer	Much poorer
Omega Chrome Brown 2R (C.I. 98)	Trifle poorer	No differnece	Sl. poorer
Omega Chrome Brown PG (Pr. 4)	Trifle poorer	Trifle poorer	Sl. poorer
Metomega Chrome Brown 3GL*	Trifle poorer	Trifle poorer	Sl. poorer
Metomega Chrome Orange ML*	Consid. poorer	Sl. poorer	Consid. poorer
Omega Chrome Orange G (C.I. 274)	Negligible	Negligible	Negligible
Alizarine Lt. Grey BS (C.I. 1085)	No difference	No difference	Sl. poorer
Omega Chrome Bl. Blue G (Pr. 299)	Sl. poorer	Sl. poorer	Consid. poorer
Metomega Chrome Yellow ME (Pr. 317)	Negligible	Negligible	Negligible
Omega Chrome Aurin GL (C.I. 219)	Negligible	Negligible	Negligible
1¼%			
Omega Chrome Brown EB (Pr. 14)	Trifle poorer	Trifle poorer	Very much poorer

* M.C.M. = Metachrome Mordant

Effect of Iron on Fastness to Decatizing

One of the final mill operations in the finishing of goods is decatizing. Certain fabrics require only a semi-decatizing which is not too severe in its affect on most good chrome dyes. However, where full decatizing is required certain chrome dyes undergo considerable shade change which defeats all the care in shade matching by the dyer. Knowing of the irregularities that have occurred in the fastness of colors normally considered good to decatizing,—we proceeded to follow up our previous findings concerning the effect of iron in fastness to carbonizing and fulling, and sent 72 swatches to a well-known worsted mill for decatizing.

Kodachrome slides have been made of these tests, some of which I will show at this time. In these slides you will observe that the presence of iron in water during dyeing does have a marked effect on the fastness to decatizing. This fact is almost astounding in top-chrome dyeing, but this damaging effect can be materially reduced, and in many cases practically eliminated by dyeing metachrome.

[*Slide No. 14, Omega Chrome Red B (C.I. 652) was shown at this point.*]

We cite particularly the case of Omega Chrome Red B. Here you will see that the Omega Chrome Red B dyed top-chrome in the presence of iron produces a very much browner shade than without iron. After decatizing,—the brownish red shade, most of which apparently is an iron lake, has been completely removed and the finished decatized piece comes back nearer to the correct shade of Omega Chrome Red B.

[*Slide No. 15, Metomega Chrome Brown 3GL*—Decatizing, was shown at this point.*]

Unfortunately the differences in shade do not show up as well in Kodachrome on dull colors but if you look at the original tests after the meeting you will

see a very noticeable change of shade in decatizing of the top-chrome dyeing made in the presence of iron. The dyed shade was much yellower but after decatizing the shade turns much redder. You will note that normally this color is quite fast to decatizing dyed top-chrome or metachrome, but like Omega Chrome Red B or other colors which are changed in shade by iron when dyed top-chrome they undergo a reversal of shade in decatizing. But as shown you in previous slides on fulling and carbonizing the dyeing of this color metachrome prevents shade damage by iron, and maintains its proper fastness to decatizing.

[*Slide No. 16, Metomega Chrome Red GM*-Decatizing Tests, was shown at this point.*]

Here again we have an excellent example of how destruction of shade by iron in top-chrome dyeing continues to plague the dyer by another permanent shade change when subjected to decatizing, not to mention what already took place in fulling or carbonizing. The original top-chrome shade (made in the presence of iron) was a dull rusty red, but after decatizing becomes much thinner, but considerably bluer. Compare the results with the tests of the metachrome dyeing made in the presence of iron, and you find no change of shade at all, being equally as fast and bright as the tests above without iron.

[*Slide No. 17, Metomega Chrome Orange ML*-Decatizing Tests, was shown at this point.*]

Here again we show a color which is normally very fast to decatizing but when dyed top-chrome in the presence of iron suffers somewhat in shade. After decatizing this damaged shade there is another change. However, when dyed metachrome with 2% M.C.M. it is unaffected by iron and excellent to decatizing.

Colors Not Affected by Iron

There are a few chrome colors which are not affected by iron, even when dyed top-chrome, which method causes the most shade change. This group therefore, cannot show any improvement in shade when dyed metachrome, and likewise show no advantage in fastness to carbonizing, fulling, light and decatizing when dyed Metachrome.

We will show at this time a few examples of this condition with particular reference to carbonizing and decatizing.

[*Slide No. 18, Omega Chrome Orange G (C.I. 274 — Carbonizing Tests, was shown at this point.*]

This color shows no shade damage from iron dyed top-chrome and therefore can show no advantages when dyed metachrome, by which method it dyed quite well. However, it is interesting to note that this color like many which are more or less immune to iron, is quite poor to carbonizing, as is evident in this colored slide.

[*Slide No. 19, Omega Chrome Orange G (C.I. 274)—Decatizing Tests, was shown at this point.*]

As in the previous slide we showed that this color is resistant to iron but as is very noticeable here,—poor to decatizing, turning very yellow. As time is limited, we cannot show all the colored slides we made, but we can tell you that our tests confirm our findings that,—where a color is sensitive to iron when dyed top-chrome, this effect is overcome by dyeing metachrome. Likewise, the fastness to carbonizing or decatizing becomes practically perfect if the color is a fast to carbonizing and decating color, but if not, the metachrome method maintains the maximum fastness to be expected of the product.

[*Slide No. 20, Omega Chrome Aurine GL (C.I. 219 — Carbonizing tests, was shown at this point.*]

Here again we have a color practically immune to iron but very poor to carbonizing. Like the previous color, Omega Chrome Fast Orange G, it is almost destroyed in the acid and baking, and does not come back anywhere near its original shade. For direct comparison with a color which is immune to iron yet fast to carbonizing, we show the next slide.

[*Slide No. 21, Metomega Chrome Yellow ME (Pr. 317)—Carbonizing Tests, was shown at this point.*]

In this slide we see the maximum for color perfection as regards the matter of iron and fastness to carbonizing. The color is unaffected by iron either dyed top-chrome or metachrome, and as you can easily see, it stands sulfuric acid immersion and baking, causes no change in the shade, and no further change after neutralizing with soda ash. Metomega Chrome Yellow ME seems to be one exception, in that dyestuffs which are not sensitive to iron,—are poor to carbonizing. In other words most of the colors which showed shade damage by iron when dyed top-chrome, and were poor to carbonizing, were unaffected in shade and practically perfect to carbonizing when dyed metachrome.

[*Slide No. 22, Brown PG (Pr. 4)—Decatizing Tests, was shown at this point.*]

Here is another case where we have a color which has good resistance to iron but like Omega Chrome Orange G and Omega Chrome Aurine GL has fastness deficiencies. Where the Orange G and Aurine GL were immune to iron damage they were poor to carbonizing. In this case Brown PG is quite immune to iron but very poor to decatizing turning very much yellower. Dyeing metachrome when iron is present will not help as you can see. If a color is poor to a certain fastness property such as illustrated here, metachrome dyeing will not help. Our only contention is that metachrome dyeing maintains the inherent properties of a color, if the color is one which suffers shade damage by iron with the attending fastness destruction.

[*Slide No. 23, Omega Chrome Aurine GL (C.I. 219)—Decatizing Tests, was shown at this point.*]

As shown in the carbonizing tests, Omega Chrome Aurine GL is unaffected by iron but poor to carbonizing, and dyeing metachrome will not help. In this slide of decatizing tests of this color we see a big change—the color turning very much greener. Whether dyed metachrome or top-chrome it is not fast to decatizing.

[*Slide No. 24, Metomega Chrome Yellow ME (Pr. 317)—Decatizing Tests, was shown at this point.*]

In contrast to this combination of conditions we have a color which combines excellent resistance to iron top-chrome with excellent decatizing fastness. This color was shown a while back as also having perfect fastness to carbonizing which is a feature common with practically every member of this series of metachrome colors.

While time has not permitted us to follow up these oddities of relation of iron immunity to fastness properties such as exhibited by such colors as Omega Chrome Red B, Brown PG and Aurine GL we see a faint pattern forming.

This group has these characteristics: dyed top or metachrome they are:

1—Unaffected in shade by iron, but
2—Poor to carbonizing or
3—Poor to decatizing, and in each case
4—Are not too well adapted to metachrome dyeing.

In contrast to this grouping we have that group of chrome colors which have the following characteristics.

1—Show no, to some damage by iron, but not when dyed metachrome
2—Very fast to carbonizing
3—Very fast to decatizing
4—Are especially adapted to metachrome dyeing.

Effect of Iron in Chrome Mordant Dyeing

To those of you who occasionally do some dyeing on a chrome mordant there also comes these same problems. As pointed out earlier in this paper, the color destruction takes place between the dye and the iron and only when chrome is injected into the bath before the dye comes

in contact with the iron can this shade-change, with the resulting decrease in fastness be overcome. If you dye on a chrome mordant you can eliminate shade-change and fastness reduction by adding 1% metachrome mordant or chromate to the water before adding the dye.

[*Slide No. 25, Omega Chrome Red B (C.I. 652) on Chrome Mordant, was shown at this point.*]

This slide shows that iron ruins the shade and results in very poor fastness to carbonizing similar to what we noted earlier in top-chrome dyeings. With 1% M.C.M. in the bath with iron present, the shade is almost equal to a standard shade, and the fastness to carbonizing is excellent. The presence of iron during mordanting causes very little dulling of shade.

Limits on Iron Content

Just where the danger point is in regards the amount of iron that can be safely tolerated in top-chrome dyeing depends entirely on the particular dyestuffs. Dyes vary in their sensitiveness. Many chrome dyes such as Silk White Green and Acid Anthracene Brown B are badly affected by *less* than one part Fe per 1,000,000 parts of water.

[*Slide No. 26, Omega Chrome Red B (C.I. 652) was shown at this point.*]

This slide shows that bad color damage begins to appear between .04% and .05% ferrous sulfate or between 1½ and 2 parts Fe per million in water but dulling begins with much less. This slide illustrates that by dyeing metachrome (the top row) no shade damage occurs even up to 2 parts Fe per 1,000,000 water. The two lower rows are top-chrome, the middle row dyed with acetate of ammonia, the lower with ammonium sulfate.

Metachrome Dyeing of Tippy Wool

To those who have certain opinions as to the level dyeing of tippy wool and believe it can only be dyed level top-chrome,—we would like to say a few words. First—I will agree that if a certain color dyes tippy metachrome it will dye better top-chrome;—that has been true since the manufacturer of the first chrome dye. However, today we have many dyestuffs which are true metachrome dyes. They dye level on most tippy wools by the metachrome method because they were engineered that way from the start. It is my belief that dyes have degrees of tippiness and probably could be rated 100-90 or 70% level dyeing on tippy wool. By proper selection of equally rated colors, good results can be obtained on difficult-to-dye stocks. If you believe that the most tippy, Australian or Texas pulled wools will hardly dye level by the top-chrome method you will be surprised how level this Metomega group will dye, and without the need of special levelling agents, some of which we have noticed cause noticeable reduction in *fastness to light and fulling.*

I have here a number of true metachrome series dyed on a tippy "A" supra wool which most chrome colors dyed very tippy or mixey. These Metomega colors dye this stock level enough to satisfy the most discriminating mill man. When dyed top-chrome the poorest stocks dye level. All dyeings were made without levelling agents of any kind. To illustrate quickly the difference in level dyeing of chrome dyes on a very tippy wool, I will show two final slides.

[*Slide No. 27, Omega Chrome Red B or ECB type (C.I. 652), was shown at this point.*]

This is dyed by 6 different metachrome methods and shows no degree of level or complete fiber coverage. Compare these results with a true metachrome red shown in the next slide,

[*Slide No. 28, Metomega Chrome Red GM*, was shown at this point.*]

where you obtain perfect fiber coverage no matter what particular chromate method you follow.

During the war our OD dyehouses kept production at an all time high because the bulk of the khaki was dyed metachrome. The return to civilian shades and the need for goods makes high production, the saving of steam and time still important, and with the added demands for increased fastness both to the requirements of the mill and the consumer, metachrome dyeing appears to be the answer. To-day there are a complete range of true metachrome dyeing colors available which give the maximum in fastness, and through their use by the metachrome method will reduce to a minimum those irregularities in carbonizing, fulling and decatizing which, I have attempted to show in this paper, — are caused by the sensitiveness of most chrome dyes to iron when dyed by the top-chrome method. By dyeing metachrome we obtain the maximum brilliancy of shade and the maximum fastness to light, carbonizing, fulling and decatizing that the manufacturer intended the dyestuff should exhibit.

References

* C.I. or Pr. numbers not assigned to date.

[1] Bird and Molloy—Soc. Dyers & Col. Jour., Nov. 1939.

[2] Bird and Molloy—Soc. Dyers & Col. Jour., July 1941.

EMPLOYMENT REGISTER

This column is open for four insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the Secretary of the Association, Lowell Textile Institute, Lowell, Mass. It is understood that these will be open to inspection by prospective employers, who can obtain further information through the code numbers from the Secretary.

47-25

Education: Lowell Textile Institute, graduate, textile chemistry and dyeing, 1932.
Experience: Eight years textile chemist and colorist in print works; inspector for Quartermaster Corps, Army of U. S.
Age 36; married; references; position as chemist or salesman in New England preferred.

47-26

Education: High school, with college extension courses.
Experience: Nineteen years with two companies, mainly skein dyeing, various fibers, in charge of department.
Age 39; married, references; will work anywhere in U. S.

47-27

Education: Graduate Pratt Institute, additional college training.
Experience: Twenty years research, development, control; biochemistry, intermediates, dyestuffs.
Age 44; married; references.

47-28

Education: Graduate, Lowell Textile Institute, 1940.
Experience: Chemical laboratory and plant control, dyes and textile resins.
Age 30; married; references.

Meeting of Rhode Island Section

THE March meeting of the Rhode Island Section was held on Friday the 28th, with approximately 125 present.

Dr. Emery I. Valko of the E. F. Drew Company, presented a paper the title of which was "Unification of Theory on Textile Dyeing."

Following Dr. Valko's paper a film entitled "Portrait of an Industry" was shown through the courtesy of the Calco Chemical Division of American Cyanamid.

Respectfully submitted,
E. A. RICHARDS,
Secretary.

The Apermeter

A New Air Permeability Determination Apparatus

JOHN H. SKINKLE* and ARTHUR J. MOREAU**

PERMEABILITY of a fabric is the ability of the fabric to transmit a gas through its interstices. For a good many years, permeability was of only academic interest and only a few rather bulky and clumsy instruments were developed for its measurement. During World War II, however, the determination of air permeability became of practical interest in the cases of balloon cloth, airplane fabric, parachute fabric, fabric to be coated, and the "wind-breaker" type of garment for the armed forces. Recent work on water resistance of fabrics has also shown that an air permeability determination as an accompanying test gives much valuable information as to the fabric; in fact, a too permeable fabric is almost impossible to make water resistant to any appreciable degree except by continuous films which then reduce the air permeability to zero and produce a fabric which is uncomfortable for wear.

At the outbreak of the war, the Frazier instrument was adopted for government contract testing, principally because it was the only reasonably satisfactory instrument being commercially produced. The Frazier apparatus works on the principle of drawing air through a known area of fabric at such a rate that the drop in pressure across the fabric is exactly 0.5 inches of water; one of several standard orifices placed in the line causes a differential head of water across it, which is read, and reference to a calibration chart gives the volume of air transmitted through a unit area of the fabric in a unit time at a standard pressure drop across the fabric. A variable-speed motor-driven fan is used to regulate the flow of air. Obviously, a high degree of standardization is necessary for reproducibility of results by different instruments. The apparatus, then, is expensive, bulky, and as will be shown later, not too accurate.

The authors have devised a new apparatus for the measurement of air permeability which they have named the "Apermeter," a contraction of the words "air permeability meter" and which is shown in Figures 1 and 2. The central portion is a condenser jacket with the ends sealed by rubber stoppers, held with a very slight slant downward to the right, so that water can drain out the lower tubing connection. Attached to this bottom outlet is a rubber tubing leading to the aspirator bottle at the right. Attached to the top outlet of the condenser jacket by a short piece of rubber tubing is a filter tube in which is a two-hole rubber stopper holding a glass stopcock and a piece of glass tubing with a right-angle bend. Another piece of heavy rubber tubing runs from this right-angle bend to the connection on the AATCC hydrostatic pressure sample holder. There are also required two circular pieces of sheet metal, 3 inches in diameter and with a ⅜ inch hole in the center; two Mason jar rubbers to fit on the compression surfaces of the sample holder are also used. All stoppers should be sealed in place and rubber tubing should be wired in place to make air-tight joints.

With the aspirator bottle resting on the table, water is added until the level of water is about 0.5 inches below the point B (Figure 1), this should be checked every day before using. The two metal plates are placed together and between the rubbers and put into the sample holder, the stopcock is opened, the aspirator bottle is raised until the water fills the condenser jacket and the level is somewhere in the filter tube, the stopcock is closed, and the aspirator bottle is replaced on the table. As the level of water falls, a stopwatch is started as it passes point A and stopped as it passes point B and the time in seconds is recorded. This should be repeated twice more and the average of the three readings recorded as the time of flow with no sample (t_o). This determination need be made only once a day unless the apparatus is disturbed in the meantime. A sample of fabric at least 3x3 inches is placed between the two circular plates and another run made; two other pieces of the

* Assistant Professor, Lowell Textile Institute.
** Graduate Student, Lowell Textile Institute.

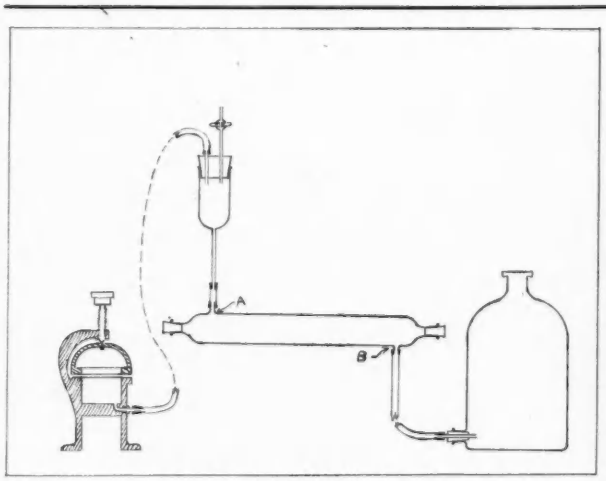


Figure 1—Cross-Section of Apermeter.

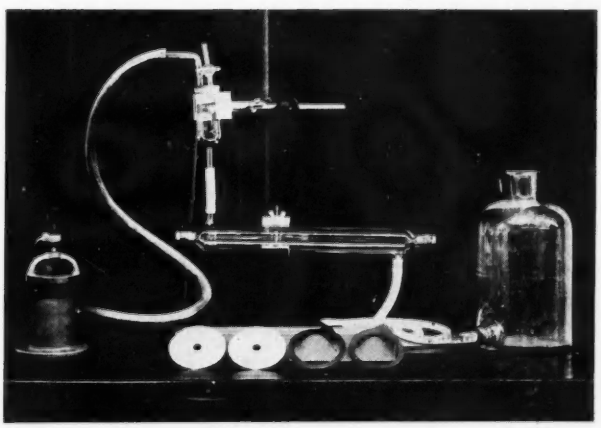


Figure 2—Photograph of Apermeter.

same fabric are tested and the average of the three determinations recorded as the time of flow with sample (t). If the volume of the condenser jacket is (V), then the flow of air through the fabric is at the average rate of V/t and the average flow of air with no sample in the apparatus is V/t_o. If we now define the air permeability as the rate of air flow through the sample expressed as percent of the maximum possible flow under the same conditions but with no sample present, then

$$\text{Apermeter value} = \frac{V/t}{V/t_o} \times 100$$

or

$$\text{Apermeter value} = \frac{t_o}{t} \times 100$$

In this apparatus, no attempt is made to have a constant differential across the fabric, this varies as the level of water in the jacket falls, but this fall always varies between the same limits as the run with no sample. Similarly, the starting level of the water in the bottle makes no difference because it is the same in both cases, the exact size of the holes in the metal discs is the same in both cases. In other words, because an initial run is made each time with no sample and because our results are expressed as a ratio to this run, all small variations in the apparatus divide out in the result, and rigid standardization is unnecessary.

In order to compare the Apermeter with the Frazier, a series of twenty-five fabrics were selected which included all types of fibers and constructions and ranged from a very low to a very high permeability. On each sample three determinations were made by the Frazier and three by the Apermeter. The average of the three values and the percent variation for each sample by each method is given in Table I. The percent variation is the standard deviation expressed as percent of the mean value. It will be noted that the average variation of the twenty-five samples was 8.1% for the Frazier and only 0.46% for the Apermeter. In order to check as to whether these variations were due to the methods or to variations in the samples, four fabrics were selected and three runs made by each method on the same spot on the fabric; in this case the variation by the Frazier method was 0.97% and by the Apermeter 0.20%. The Apermeter, therefore, gives a better average value.

The correlation between the Frazier and Apermeter, as shown by the Kendall coefficient is 87%, indicating that both methods are measuring the same thing.

TABLE I
Comparison of Frazier and Apermeter

FRAZIER			APERMETER		
Mean	% Variation	% Var. one spot	Mean	% Variation	% Var. one spot
1.75	13.8	1.35	68.0	0.46	0.05
2.99	13.0		77.0	1.54	
3.29	5.7		86.3	0.35	
3.34	4.4	1.75	83.5	0.12	0.16
4.65	4.5		83.5	0.76	
5.17	8.7		85.6	0.49	
5.36	6.0		81.7	0.51	
5.45	3.4	0.00	84.8	0.52	0.17
8.13	16.5		87.3	0.89	
8.86	7.3		84.8	0.85	
18.8	1.5		91.2	0.73	
20.1	9.0		91.3	0.39	
35.7	8.7		93.2	0.45	
36.6	8.8	0.78	94.5	0.23	0.40
51.6	9.0		97.2	0.32	
52.6	18.6		96.7	0.15	
61.5	1.6		97.6	0.43	
64.2	9.1		97.6	0.49	
64.9	2.8		97.6	0.36	
66.9	12.4		95.5	0.64	
68.6	6.6		97.6	0.15	
117.	10.2		98.1	0.49	
124.	9.9		92.2	0.57	
187.	4.1		98.4	0.32	
285.	6.7		99.8	0.52	
Average	8.1%	0.97%	Average	0.46%	0.20%

Correlation by Kendall coefficient = 87%.

Comparison of the values in Table I and Figure 3 shows that the Frazier is most sensitive to small differences in the high permeability range while the Apermeter is most sensitive in the low permeability range; since, in most cases, it would be used on fairly low permeability fabrics, this is an advantage for the Apermeter.

Figure 3 is a plot of the data of Table I, showing the relationship between the Frazier and Apermeter values. It will be noted that the points define a smooth curve. Replotting the data as the ratio of Frazier value to Apermeter value against the Frazier value (Figure 4) gives a straight line for which the equation is:

$$\frac{F}{A} = .010F + .010$$

The parts used in the Apermeter are all standard equipment except the circular plates, which can be easily made. The sample holder is the holder for the AATCC hydrostatic pressure test for water resistance and is normally available in any testing laboratory. The rubber rings are ordinary Mason jar sealing rubbers, 2¾ inches outside diameter. The glassware is all standard equipment and may be obtained from any laboratory supply house. The total cost of the glassware is about five dollars. In case it is desired to reproduce the apparatus, the following specifications may be of help:

Hydrostatic pressure sample holder
H. C. Chapin, Secretary, AATCC,
Lowell Textile Institute, Lowell, Mass.
Bottle, aspirator, tubing outlet, 2-liter
No. 10515.
Condenser jacket, 300 mm. No. 14400B.

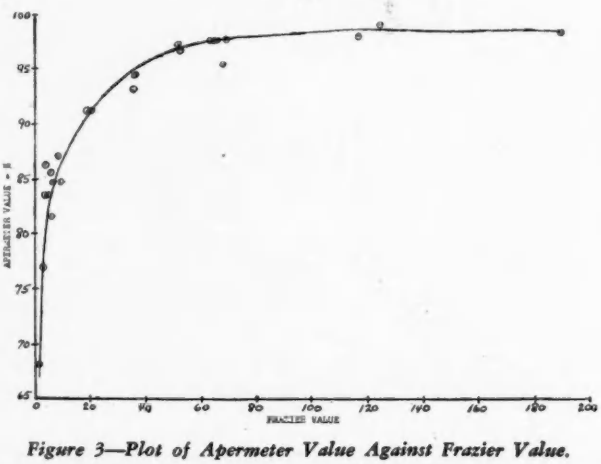


Figure 3—Plot of Apermeter Value Against Frazier Value.

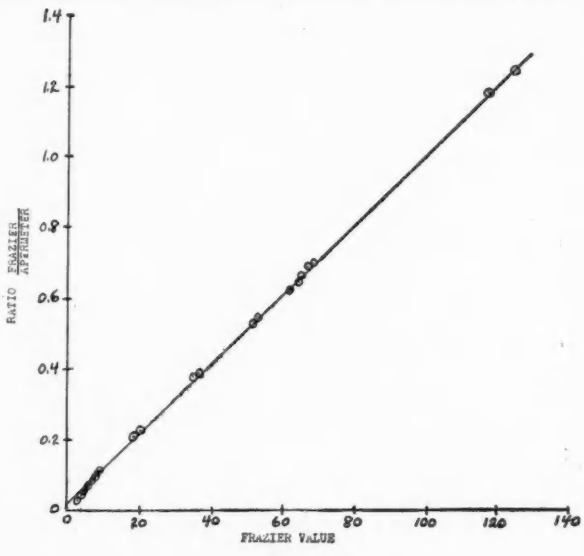


Figure 4—Plot of Ratio $\frac{\text{Frazier}}{\text{Apermeter}}$ Against Frazier Valve.

Filter tube, carbon filter, 36.5 mm. No. 15172D.

Stopcock, two-way, straight bore No. 1 No. 15406.

Central Scientific Company,
79 Amherst St., Cambridge A, Mass.

2—Mason jar rubber rings, 2¾ inches outside diameter.

2—Thin sheet metal circles, 3 inch diameter, ⅜ inch hole in centers.

The authors would like to express their appreciation to Jacob Frederick of the Control Laboratories of the Textron Company for the use of the Frazier apparatus and to Mrs. Lang of the same laboratories for determining the Frazier values.

ABSTRACTS FROM CONTEMPORARY JOURNALS

Report of the Committee Appointed by Council to Discuss the Dyeing Properties of Direct Cotton Dyes

Journal of the Society of Dyers and Colourists, page 280, Vol. 62, No. 9, September, 1946.

This represents the report of a committee of the Society of Dyers and Colourists consisting of representatives of dye manufacturers, dye users, research workers, etc.

The committee concluded that the following factors and properties are adequate to define the dyeing behavior of direct dyes for most purposes: (1) migration or levelling power; (2) salt controllability; (3) influence of temperature on exhaustion; (4) influence of liquor ratio on exhaustion. A classification according to the following scheme is recommended: *Class A*—dyes which are self-leveling, i.e., dyes of good migration or levelling properties; *Class B*—Dyes which are not self-levelling, but which can be controlled by regulated additions of salt to give a level result (these dyes may be defined as "salt controllable"); *Class C*—Dyes which are not self-levelling and which are highly sensitive to salt. The exhaustion of these dyes cannot adequately be controlled by addition of salt alone and they require additional control by temperature. They may be referred to as "Temperature controllable."

The test for migration or levelling power is carried out on 2/40 American bleached yarn having a medium doubling twist (about 15 T.P.I.) and having a fluidity value not exceeding 5 when measured in a standard cuprammonium solution. A hank of yarn is dyed with the dye under examination in a 1% shade, the amount of dye required being in terms of the standard brand. The dyebath is prepared with the appropriate amount of dye in distilled water, to which is added 20% common salt (on weight of yarn) and is used at a liquor-goods ratio of 30:1. The bath is brought to b.p., the dry hank entered and dyeing carried out by boiling gently for 30 min. The dye hank, which shall be uniformly dyed, is squeezed to remove excess liquor and is then dried. The dry hank and an equal weight of undyed bleached yarn are treated in a bath composed of distilled water to which is added 10% common salt (on total weight of yarn) at a liquor-goods ratio of 30:1 for 30 min. at b.p. The hanks are then squeezed to remove surplus liquor, dried and compared.

A number of dyestuffs have been recommended as standards. If the dye under test migrates as well as, or better than, one of the standards, it is placed in Class A. If not, it is placed in either Class B or C determined by an additional test for salt controllability.

The test for salt controllability is carried out on the same yarn as for the previous test. Three dyebaths are prepared, each with the appropriate amount of dye to give a 1% shade, using distilled water and a liquor-goods ratio of 30:1. To these dyebaths are added 0.6%, 0.8% and 1% common salt, respectively, and three separate dyeings are made, boiling gently for 30 min. Each hank is then removed and squeezed, the surplus liquor being returned to the dyebath. To each of the three dyebaths is then added sufficient common salt to bring the total concentration to 20% and a second dry hank of yarn is entered and dyed by boiling gently for 30 min. The three pairs of hanks are dried and compared.

If all the first dyeings are lighter than the corresponding second dyeings, or if any one of the first dyeings is of the same depth as the corresponding second dyeing, the dye is placed in Class B. If all the first dyeings are darker than the corresponding second dyeings, the dye is placed in Class C.

There are several factors which affect the reproducibility of this test and, accordingly, a number of dyes have been selected as standards which are used as controls.

The exhaustion of a dye may be controlled by gradually increasing the temperature of the dyebath.

Decreasing the liquor ratio increases the rate at which a dye is absorbed and the amount absorbed at equilibrium. The degree of control by means of salt additions is diminished. A given percentage of salt has a greater influence on the exhaustion as the liquor ratio is decreased.

The second part of this paper gives an outline of the activities of the committee and in the appendix are found the names of the committee members, description of apparatus, and a list of dyes which have been tested and classified.

Modern Organic Chemicals in the Textile Industries

W. H. Dicken and D. H. Stott, Textile Manufacturer, page 436, Vol. 72, No. 860, August, 1946.

This article discusses the development and possibilities of new types of synthetic chemicals. Among the chemicals covered are: glycols and glycol ethers, water-soluble waxes, amines, wetting agents and plastic finishes.

The Application of "Hiparol" and Bacterial Enzyme Preparations to Modern Jute Spinning Practice

C. M. Watson and H. K. Baruah, Textile Manufacturer, page 434, Vol. 72, No. 860, August, 1946.

"Hiparol" is a mixture of enzymes extracted from *Thielaviopsis Paradoxa*, which will ret jute, cocoanut, and other fibrous plants. If the bacteria responsible for retting are isolated, cultured and added to water in which fibrous plants are stacked, it is possible to enrich the water by the particular bacteria, and also by the bacterial enzymes produced in culture, thereby hastening the separation of the fiber bundles from the cortex and wood and thus ensuring greater ease of retting without impairing the quality and tensile strength of the fiber. Samples of cloth prepared from jute root cuttings treated by "Hiparol" and bacterial enzymes show greater weights/sq. yd. and higher tensile strength than the standard mill quality samples, the weft yarns being more compactly spun due to better softening of the treated cuttings indicating no enhancement of fiber slippage due to processing, and no weakening effect of the treatment on the fiber. Considerable savings in processing and handling charges are indicated and the possibilities of utilizing fibrous plants more economically are increased.

(Concluded on Page 252)

• PATENT DIGEST •

PAUL WENGRAF

Dyeing Acetate Cellulose—Fumeproofing C, 4, 07

U. S. Pat. 2,409,257

(Celanese Corp. of Amer., Croft-Waller, Oct. 15, 1946)

Many dyestuffs yield on cellulose acetate fabrics desirable shades, fast to washing, but a great part of them suffers by acid fumes. A strong discoloration is particularly observed upon exposure of textiles to combustion products of coal tar, gas and the like. Frequently this drawback occurs in dyeing with blue dyestuffs of the anthraquinone series. (compare abstract to U. S. Pat. 2,403,019, The present invention suggests to counteract acid fading by a treatment with a triethanolamine solution, containing a swelling agent, preferably a lower alcohol for acetate of cellulose. An example describes a treatment of cellulose acetate dyed in a blue shade with 1 per cent of 1:4 dimethylaminoanthraquinone in a solution containing 32 p. triethanolamine, 320 p. ethanol and 600 p. water. The fabric was found to retain 1.38 per cent triethanolamine after drying. The thus treated samples were only slightly reddened after 40 hours exposure while untreated samples had completely faded to a pink shade by the acid fumes. Aliphatic *hydroxy monoamines,* having longer chains, are protected for the same purpose by U. S. Pat. 2,409,-325 (same date, assigned to the same company by the inventors Ward and Pull). Examples for the hydroxyamines, protected by this patent, are amino- or diethanolamino-heptanol. It has been observed that superior effects are obtained by applying to the textile material, before or during this treatment cation active agents, for example Sapamine KW.

Reference: The company obtained many patents, relating to fumeproofing of cellulose acetate. The principle is a treatment with an organic base. One of the first patents, mentioning an aftertreatment of dyed acetate of cellulose with organic compounds is U. S. Pat. 1,985,-248 (Celanese) recommending urea or its derivatives as addition to dye-or aftertreating baths and U. S. Pat. 1,972,-111 (same company), proposing an aftertreatment with thiourea in order to increase the (light-) resistance of the fibers.

Cellulosic Yarns—Pre-Treatment A, 7, 01

U. S. Pat. 2,411,429

(Courtaulds Lim., Hegan-Sharples, Nov. 29, 1946)

It is known that twisted cellulosic yarns, particularly viscose, have to be treated with steam in order to set the twist. Unfortunately steaming of the yarns reduces the affinity of the fiber to different dyestuffs and the outer layers, being more exposed to the action of the steam, are more influenced. Thus uneven dyeings result after working up the pretreated yarns into fabrics. The aim of the present invention was therefore to stabilize cellulosic yarns towards the influence of the steam. A favorable effect was observed by treating the yarn in cake form in an autoclave in hot water at 120° C. for 15 minutes. After winding the yarns from the cakes on bobbins and giving them a twist as usual, the steam-setting process did not cause any irregularities in the subsequent dyeing process.

References: Uneven dyeing of viscose is generally believed to be caused by differences in the tension exerted on the yarns. These different tensions result in the winding operation when the filaments are still in a rather plastic state. Various devices have been designed to compensate these differences: see for example U. S. Pat. 1,992,897 (North Amer. Rayon) Brit. Pat. 424,824 (Kunstzjide) etc.

Animal Hairs—Increasing Felting Properties A, 2, 03

U. S. Pat. 2,411,725

(B. Stetson Comp., Hodshon-Tucker, November 26, 1946)

Animal hairs, used for making hats, have very poor felting properties. The process for increasing these felting properties, called "carroting" has been carried out in former times by a mercury nitrate treatment. The imminent danger of poisoning by the necessary ingredients was later on avoided by treating the hairs with different acid oxidizing agents. Anyhow the process required a hand operation by brushing the carroting solution on the skins before removing the fur. It would obviously be easier to separate first the fur hairs and to carrot them thereafter in order to avoid handling the material in poisonous or strongly acid liquids ("hand carroting"). Removing first the hairs and carroting them later is termed as "pot carroting," but up to now this method did not meet any success because in the drying operation the inner layers of the bulk became damaged through the increased concentration in the center while the outer layers dried out. Objectionable results occurred, especially in manufacturing felts, mixed with wool. A solution to this problem was found in the use of non-aqueous organic solvents in a carroting combination of chloric acid, sulfuric acid and hydrogen peroxide, or nitric acid and hydrogen peroxide and so on. The organic solvents used are alcohols or hydrocarbon solvents ("Solvesso"). An example is a solution of 1 g. Hg, 10 ml HNO_3 conc. and 100 ml ethanol. The organic solvent may also contain some water but not more than 50 per cent.

Reference: Carroting — either with or without using mercury salts — is generally carried out in aqueous solutions. The U. S. Pat. 2,087,854 — 57 (The Non Mercuric Carrot Company) proposed to add some organic compounds to the mercury-free carroting solution (alcohol, acetone, triethanolamine) in order to protect the fiber from discoloration.

Creaseproofing Textiles—Thiocyanate as curing agent G, 2, 04

U. S. Pat. 2,411,818

(Heberlein Pat. Corp., Weiss, Nov. 26, 1946)

It is know by several publications, many of them also originating from the assignee of this patent, the Heberlein Pat. Corp., to treat cellulosic fabrics with formaldehyde in the presence of an acid catalyst. This treatment makes fabrics crease- and shrinkproof but it has the drawback to give them at the same time a limp hand and to cause a certain decrease in the resistance to abrasion. A substantial improvement was found here in combining the formaldehyde treatment with an impregnation with some of the usual finishing agents, such as starch pastes, gum solutions and so on. According to an example the fabrics are impregnated on a padding machine with an aqueous paste, containing wheat starch and formaldehyde to which ammonium thiocyanate is added as a curing catalyst. The aftertreatment consists of heating the material for 20 minutes to about 120° C.

References, concerning some older patents using formaldehyde without any resin forming compound, U. S. Pat. 2,-242,051: (Heberlein-Beck) dialdehydes are used as impregnating agents after drying the fabrics are baked in order to get a permanent finish); Brit. P. 565,337: (Heberlein) textiles are padded in a solution of formaldehyde, zinc chloride, potassium alum and soluble starch; a combination of formaldehyde with etherifying or esterifying agents is suggested.

Milling Cloth, From Cell-Wool Blended Wool A, 3

Dan. Patent 64,897
(A. Th. Boehme, Oct. 21, 1946)

The patent relates to a new milling process, using polysaccharides, esterified with oxycarboxylic or oxysulfuric acids. It tends to avoid completely the use of any fatty compounds in fulling operations. An example says that a piece of cloth, consisting of 30% pure wool, 40% short (carding) wool and 30% cell. wool (staple) has to be cleaned first to remove any traces of fats. Thereupon it is treated with a fulling liquid, containing 100 g. of the sodium salt of cellulose glycollic acid in 10 liters of water. This liquid is about neutral (pH = 7.5). After one hour and 55 minutes working, the fabric has shrunk from 51.0 m. to 38 m. in length and from 2.10 to 1.40 m. in width. A good fulling effect is said to be obtained within this time. Additions of potassium formate or sodium lactate to the milling solution are suggested. Another

Dan. Patent 64,932
(Graf, Oct. 28, 1946)

proposes to use alkyl celluloses as fulling agents. The liquid is prepared in this case as follows: 10 kg. cellulose methyl ether are dissolved together with 5 liters (concentration?) of an appropriate emulsifying agent, for example a fat alcohol sulfate, in 100 liters water while stirring. Two pieces of uniform cloth (weight 65 kg.) are cleaned and every fatty substance is thoroughly removed. Thereupon they are first soaked in 10 liters of the solution, mentioned above and soda ash is added. The moist fabric is treated in a milling machine with 30 liters of this solution until the desired dimensions are attained.

References: (to Dan. P. 64,879): (Parallel Ger. P. 748,755, 1944): the condensates of fatty acids with polylacohols such as sugars of the sorbitol, or erythritol type are recommended in Brit. P. 417,654 as fulling agents. *Example:* Cocoanut oil fatty acids condensed with erythritol. (to Dan. P. 64,932): According to a report in *Melliand Textilberichte,* Sept., 1943 p. 409 (Anonymous) it is suggested to use methylcellulose (tradename "Tylose") as a fulling agent. It is said to have not only an outstanding felting effect but to be at the same time completely innocuous to the fiber structure.

Chlorite Solutions—Preparing B, 5

Brit. P. 577,054
(Domsjoe Aktiebolag, May 2, 1946)

Previous methods for preparing ClO_2 consisted according to U. S. Pat. 2,089,913 (Mathieson Alkali Works) of reducing an aqueous solution of a chlorate by means of SO_2. Hereby mixtures of ClO_2 and Cl_2 were obtained in which the ratio was about 5:1 to 10:1. It has been found that this method could substantially be improved by causing gaseous sulfurous oxide to react on the chlorate in an aqueous solutions, previously acidified with sulfuric acid (or quite *generally a non halogenic* acid) of about 7-8 normal strength. The presence of free H ClO_2 is assumed.

Reference: Chlorite quite well known under the tradename as "Textone" was first recommended in the U. S. Pat. 2,089,913 (mentioned above), for bleaching purposes in combination with chlorine dioxide. The same company obtained U. S. Pat. 2,358,866, suggesting to add peroxide to bleaching chlorite solutions and U. S. Pat. 2,353,823 described additions of persulfate in an analogous process.

Coating—Moistureproof Textile Fabrics— G, 2, 02

Brit. P. 577,256
(Monbiot, May 10, 1946)

Moistureproof coatings are obtained by using ethylcellulose as a fiber forming agent mixed with a normally liquid chlorinated diphenyl (for instance the product available in the trade under the name "Aroclor 1254") and a wax-like material as a water repellent substance. The preferred percentage is:

54.6 p. Aroclor
37.0 Ethylcellulose
8.4 Paraffin wax.

References: Chlorinated aromatic ethers are used as flameproofing agents according to U. S. Pat. 2,073,010 (du Pont); phosphoric acid esters of diphenyl are flameproofing finishes forming substances as disclosed in U. S. Pat. 2,033,918 (Dow Chem.). U. S. Pat. 1,975,072 (Swann Research) protected the use of chlorinated diphenyls + metal soaps + waxes as flame- and waterproofing coatings.

Textile Fabrics—Rubberized G, 2, 02

Brit. P. 577,291
(Callender's Cable et al., May 13, 1946)

In the art of rubberizing textile fabrics it has been common practice to dip the fabric in latex concentrate or to apply latex to the fabric in some other way and to callender it thereupon. By none of these methods the rubber is sufficiently firmly bound to the fabric. The present invention causes depositing a metal which is *attacked by sulfur* under the usual vulcanizing conditions, then applying the rubber dispersion (latex) and finally vulcanizing as the last step.

References: U. S. Pat. 2,340,357-58 (United States Rubber Company) proposes as another method for coating textiles with latex to mix the dispersion with a known textile assistant of the "Gardinol" or "Igepon" type, just enough to prevent coagulation but not so much that it counteracts the coating process itself. Some mixtures of latex with resins dissolved in hydrocarbons, proposed, for instance in U. S. Pat. 2,346,083 (Resinous Products), have the purpose to make latex better adhere to the fibers surface. Alkyd resins or urea-formaldehyde resins are best suited for this mixed compositions.

Shrinkproofing Wool. Peroxide Treatment A, 2, 04

Brit. P. 579,584
(Bleacher's Assoc., Schwabe-Parker-Farrington-Stubbs, August 8, 1946)

The tendency of fabrics, containing animal fibers, to be reduced in surface area, in other words, the property of shrinking may decrease by a treatment with an aqueous solution of peroxides or persalts at a pH of 8-12: (see Brit. P. 553,923, granted to Bleacher's Association). Two main reactions take place at the same time. (1). the interaction of wool with H_2O_2 and (2). the decomposition of H_2O_2. It is desirable to maintain such conditions that the first reaction proceeds more rapidly than the second one. A process for favorably influencing the reaction so that the greater part of the hydrogen peroxide is used up for combining with the wool substance has now been developed in the present patent. The fibers have to be pre-treated in order to open the disulfide-linkages. Appropriate pre-treatments are for instance carried out with sulfite, bisulfite, metabisulfite and hydrosulfite solutions. In an example a woven fabric is treated with a 2.5% Na_2SO_3 solution (pH = 7), rinsed in cold water and after-treated with an H_2O_2 solution of 2 vol. for 3 hours at a pH = 10. Shrinking was substantially eliminated.

Reference: U. S. Pat. 2,351,718 (Speakman) describes reducing of wool or hair shrinkage by treating the material with sulfite and oxidizing it after rinsing and stretching with peroxide. The kind of treatment, as described in the present patent, as well as in Speakman's patent comprises therefore a special application of the usual oxydizing, (for instance chlorinating, etc.) shrinkage removing treatment combined with the opening of disulfide linkages by sulfites.

TRADE NOTES • NEW PRODUCTS

• New Butterworth Machines

How deliveries of textile machines can be accelerated by production of parts that are interchangeable is a current research project of H. W. Butterworth & Sons Company.

The progress made so far is reflected by new tenters now in production and by a horizontal pad that is literally six machines in one.

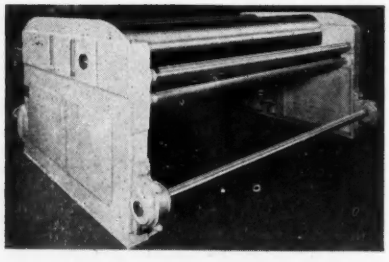
The Butterworth Straight Automatic Tenter, which operates at speeds in excess of 200 yards per minute, and the Butterworth Mercerizing Tenter use the same drive shaft, reduction heads, bearing support rails, etc.

The new Butterworth 3-Roll Horizontal Padder is actually six machines under one streamlined cover. With minor variations in boxes the Horizontal Padder becomes an Extracting Mangle, a Caustic Impregnator, a Universal Padder or a Starch Mangle. Or with a change of rolls the machine becomes a 15-Ton Rayon Calender. Rolls of any diameter can be used without new parts or major revisions.

In addition to accelerating the production of machine parts the Butterworth program is giving mill owners more versatile equipment. Machines can be changed over quickly and easily whenever required by advances in textile chemistry.

Butterworth Machines are being built in improved designs. Streamlined covers (of stainless steel where necessary) protect all working parts and act as safeguards against accident. These covers are also designed to prevent the splashing and leaking of liquor. This results in a saving of chemicals and eliminates puddles and damp floors.

Because these machines are expected to be versatile enough to run cotton, wool and rayon as well as new fabrics it is essential that the operator have complete control of all mechanical variations at all times. Therefore all controls are built into the machines within easy reach of the operator. New meters and indicators are said to afford positive and close control.



Butterworth 3-Roll Horizontal Padder

• Alrosene 31

Alrose Chemical Co., 180 Mill Street, Cranston, Rhode Island, announces the production of Alrosene 31, a new synthetic detergent. It finds its main application in soaping prints, improving shade brightness and hand, eliminating scumming, and reducing color bleeding. As a scouring agent for raw wool, rayons, acetates, cottons, it is said to permit operation at lower temperatures, causes no lime soap deposits, discolorations, rancidity, or interference with further processing. The product is also suggested as a levelling agent and penetrant with acid dyes, vats, developed, sulfurs and direct colors.

• Joins Orr & Sembower

J. E. Simpson has been appointed director of the newly created Chemical Development Division of Orr & Sembower, Inc., long-established manufacturer of steam generating equipment. This new Division will include research, development, manufacturing, sales, and sales service activities, principally devoted to industrial processes utilizing surface-active materials. Headquarters will be at 138 South Fifth Street, Reading, Pennsylvania.

During the past 4½ years, Dr. Simpson directed research and development work for the Quartermaster Corps in the field of surface-active chemicals. He assumed his new duties March 1st.

• A.I.C. Medal Award

The American Institute of Chemists held its twenty-fourth Annual Meeting, May 2, 1947, at the Hotel Commodore, New York, at which the gold medal of the Institute was presented to Dr. M. L. Crossley, director of research, American Cyanamid Company, in recognition of his scientific work, leadership in research, and activities in behalf of the profession.

Speakers at the medal dinner were: Dr. Henry M. Wriston, president, Brown University, "Crossley as I Know Him"; Dr. Arthur J. Hill, director, Sterling Chemistry Laboratory, Yale University, "The Scientific Achievements of Dr. Crossley"; S. C. Moody, vice president, American Cyanamid Company and general manager, Calco Chemical Division, "Crossley in Industry." Dr. Foster D. Snell, president, The American Institute of Chemists, made the medal presentation. Dr. Crossley's acceptance address was on the subject of "Research and Human Welfare."

• Monsanto Research Group Leader

The promotion of Dr. Robert A. Ruehrwein to Research Group Leader in the Central Research Department of Monsanto Chemical .Company at Dayton, Ohio, was announced by Dr. Carroll A. Hochwalt, Monsanto's Central Research Director. Dr. Ruehrwein will be in charge of the Physical Chemistry Research Group.

• Schwellenbach to Speak at Seminar

Lewis B. Schwellenbach, secretary, U. S. Department of Labor, will be one of the principal speakers before the National Textile Seminar, to be held May 12th to 16th inclusive at Shawnee-On-Delaware, near Stroudsburg, Pennsylvania.

Secretary Schwellenbach will address the session on Industrial Relations on the evening of May 15th.

• Join National Cotton Council

The National Cotton Council of America has announced the following additions to its Department of Technical Service: George S. Buck, Jr., Former Superintendent of the Finishing Department, Wm. F. Hooper and Sons Company, will be in charge of all activities of the Department relating to the finishing and processing of yarns and fabric; Henry A. Rutherford, Former Assistant Director of Research, Milton Harris Associates, will be in charge of all activities of the Department relating to physical and chemical research on fibers, yarns, and fabrics.

• Fiber Extensometer

Development of a new apparatus for studying the load-elongation properties of single fibers is announced by Harris Instruments, Inc., 1246 Taylor Street, NW, Washington 11, D. C. Based on the principle of an automatic Chainomatic balance, the Sookne-Harris Fiber Extensometer is a research instrument which produces an ink-drawn record of the load-elongation characteristics of almost any textile fiber. Recording is accomplished by a capillary-flow pen on ordinary graph paper. Several ranges of loads and rates of extension are provided. In addition to the load-elongation curve to the break,

one or more hysteresis cycles can be readily obtained to permit the study of a fiber's ability to recover from extension. The machine records in a form suitable for the evaluation of the fundamental quantities obtainable from load-elongation curves, such as Young's Modulus, work required to elongate to a given extension, temporary set, etc. Relaxation curves, in which the rate of decay of tension at a constant elongation is studied, are likewise within the scope of the instrument. It is thus capable of providing detailed information of the time-load-extension properties of single fibers. With very slight modification, the apparatus is also capable of providing sensitive measurements of the folding properties, especially flexibility and resilience, of lightweight fabrics, or the compressional properties of pile fabrics at very low pressures.

• Felt Association Officers

At the annual meeting of the Felt Association held in New York, April 7th and 8th, Arthur Sudduth of James H. Rhodes & Co., Chicago, Ill., was elected president. He succeeds L. H. Hansel, president of The Felters Company, Boston, Mass.

Cornelius Hubner, president of Central Felt Company, Inc., New York, was elected vice president of the Association.

Appointed members of the Board of Directors were J. T. Lawless, president American Felt Company; Herman G. Berglund, Standard Felt Co., and L. H. Hansel. Herbert S. Blake, Jr., president, Organization Service Corporation, was re-elected secretary-treasurer.

Headquarters of the Association are 74 Trinity Place, New York, 6.

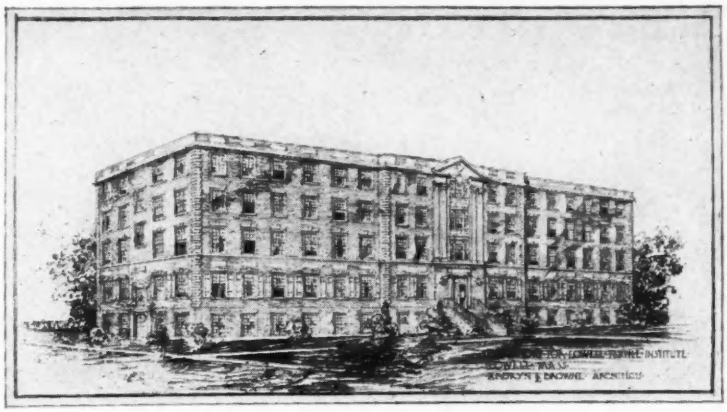
• New Monsanto Plant

Monsanto Chemical Company has announced the opening in Springfield, Mass., of a new plant for the manufacture of the company's textile-treating chemical known as Resloom. The Springfield plant will have a yearly output capable of processing 50,000,000 yards of fabric.

Dr. Donald H. Powers, director of Monsanto's textile chemical department, said the increase in Resloom production will bring in greater volume to the average housewife such desirable items as dresses that will emerge unwrinkled from suit cases, clothing that will hold shape after prolonged wear, and blouses and blankets that can be safely laundered in the Monday wash.

"At the present time Resloom has gained acceptance in 50 processing mills of variods types," Dr. Powers said. "Already thousands of women's suits and dresses, as well as men's shirts and other garments have been manufactured from fabrics treated with Resloom. Not only have we accumulated a great amount of technical data needed in connection with a new product, but we have also gained assurance that Resloom is now ready for a broadsale entry into textile markets."

• Lowell Textile Dormitory Building



Shown above is the architect's drawing of the new dormitory to be constructed at the Lowell Textile Institute, Lowell, Mass. A story on the ground-breaking ceremonies for this building appeared in our last issue.

• PTI Alumni Outing

The 46th Annual "Cruise" of the Alumni Association of the Philadelphia Textile Institute will be held at the Manufacturers' Golf and Country Club in Oreland, Pa., on Friday, June 6th, it was announced recently by Edwin G. Michie, General Chairman of the "Cruise" Committee. Golf, tennis, swimming, and informality will be the order of the day. The annual meeting of the Association will be held at 11 a.m. so as to occasion the least interruption to a day of pleasure.

Prizes will be given to the winners in the Annual Association Golf Tournament. Robert H. Crompton, Jr. PTI '34 heads the Golf Committee.

The Officers and directors of the Alumni Association urge the attendance of all those who have attended the Philadelphia Textile Institute to join them on this occasion whether or not members of the Association. Reservations should be sent to Mr. Frank L. Giese at the Philadelphia Textile Institute, 320 S. Broad Street, Philadelphia 2, Pa.

Other members of the "Cruise" Committee are: Walter F. Fancourt, III '33, in charge of the entertainment, Nelson K. Fite, '30, and Dominic A. Siravo, '40, are handling the gifts and prizes, Howard P. Galloway '31, and Emil R. Pohlers '26, in charge of publicity.

• Joins Bryant Chemical Corp.

Joseph A. Bryant, well known for over half a century throughout the Textile Industry, has announced that he has joined his sons in the Bryant Chemical Corporation.

Mr. Bryant will make his headquarters at the company offices in Quincy.

• Move Carbide & Carbon Office

Carbide and Carbon Chemicals Corporation has moved its Los Angeles district office to 416 West Eighth Street, Los Angeles 14. This was announced by Alfred C. Ross, district manager in charge of the Los Angeles office. Mr. Ross has been associated with the Corporation since 1935 and has been located in Los Angeles for the entire period. The company is the chemical producing Unit of Union Carbide and Carbon Corporation.

• New Monsanto Sales Office

Opening of a new Monsanto Chemical Company sales office in Boston to handle regional sales of organic chemicals, phosphates, alcohol and dry ice, and to serve as a divisional branch for the company's export sales and shipping department, has been announced.

The organic and phosphate sales staff in the new office, at 140 Federal Street, will be headed by Thornton Jesdale. Paul Huntington will have charge of alcohol and dry ice sales, and Robert E. Holmes will head the export sales and shipping department branch.

The office will serve solely as a sales unit. Financial transactions will continue to be carried on at the company's Merrimac Division at Everett, Mass.

Abstracts—

(Concluded from Page 247)

Some Aspects of the Drying and Heating of Textiles. Part I—The Moisture in Fabrics

J. M. Preston and J. C. Chen, Journal of the Society of Dyers and Colourists, page 361, Vol. 62, No. 12, December, 1946.

This paper covers an investigation of fabric temperatures and rates of drying using infra-red heating. The critical moisture content has been defined by others as the just saturated condition. The critical moisture content is important as it defines the condition of the material at which the drying rate suddenly starts to fall. Prior to it being reached the drying rate is constant. Under steady drying conditions, textile materials have a steady temperature until the critical moisture content is reached. As this is reached the drying rate starts to fall and the temperature to rise. These changes continue until all the water has evaporated. At this stage there is no longer any energy loss due to vaporization, so that all the energy must be dissipated by radiation and convection. As soon as the temperature of the material has risen sufficiently for this to occur, it again becomes steady. The critical moisture content in different materials was investigated by following the temperature changes during drying and to compare these temperature changes with the weight changes which occur simultaneously. Critical moisture contents for a number of fibers is given.

Part II—The Use of Infra-red Radiation

This section records the results of an investigation of factors affecting the absorption of infra-red radiation.

Developments in Retting and Decortication of Flax

Textile Mercury and Argus, page 95, Vol. CXV, No. 2991, July 19, 1946 and page 149, Vol. CXV, No. 2992, July 26, 1946.

Mechanically separated linen fibers acquire a better white than retted fibers and with less drastic bleaching treatment. Unretted linen fibers are coarser and do not spin normally to fine counts. In any method for separating linen fibers from the stalks care must be taken not to break the long linen fibers into shorter lengths.

A new process has been developed in which the flax, freshly pulled and without retting, is given two aqueous treatments in succession, both of which are capable of removing impurities sufficiently to allow the subsequent mechanical processes to be effective. The treatment does not produce any appreciable shortening of the fibers. The first treatment uses hydrochloric or other mineral acid in a concentration around ½ to 1% in the presence of a substance such as sodium hexametaphosphate. The treatment is carried out for two or three hours at 60 to 100° C, rinsed and allowed to lie for 4 or 5 days taking care not to allow local drying. The second stage involves immersing the acid treated flax in an alkaline or acid liquor containing emulsifying agents or soaps. When the alkaline liquor is used a better bleach may be obtained.

The machine used to remove impurities from the flax consists essentially of a framework mounted over a large trough and comprises a series of suitably spaced pairs of rollers. The alternate pairs form one set and are of the pressure type, so that the flax stalks passing through them are crushed and the solid impurities loosened. The other rollers are not subjected to appreciable pressure. They are covered with rubber strips and rotate at a speed adjustably higher than the other set.

A retting process has been developed whereby air is blown through the liquor so that it becomes neutral and then alkaline and may be used over again a number of times. The liquor may also be purified by circulating the liquor over a bed of broken stones, exposing it to the air, and returning it to the retting tank.

Reference is also made to an improved machine for mechanically decorticating flax.

Wetting of Textile Materials—

(Concluded from Page 226)

All wetting agents, when examined in the manner described here, show similar families of curves, though the concentration levels may be different. This would mean that knowledge of the Draves sinking time of a solution would permit the prediction of the ultimate buoyancy that would be attained by a skein exposed to that soluion. If this is true the Draves test provides an adequate description of wetting agent performance. (2) Some wetting agents combined both the property of short Draves sinking time and low ultimate buoyancy. If this is true these might be preferable even at higher cost.

Although no evaluation study is given here, the description of observations of the wetting process at "wetnesses" greater than those accessible to sinking type tests and elucidaion of the general type of relationships that may be expected among sinking type tests for various loadings were considered to make this material worthy of note.

Bibliography

(1) Carl Z. Draves, "Evaluation of Wetting Agents," Amer. Dyestuff Reporter, *28*, 425 (1939).

(2) J. W. Illingworth, "The Density of Textile Fibers," Textile Recorder, August 1944, page 61.

(3) J. Powney, "The Penetration of Fabrics by Detergent Solutions," Wetting and Detergency, A Harvey, London (1937).

(4) F. D. Farrow and S. M. Neale, "Wetting of Raw Cotton by Hot Starch Pastes," Jour. Text. Inst., *16*, T-209 (1925).

TABLE I

List of Surface Active Preparations Examined, all of which showed crossing of Time-buoyancy Curves for Various Concentrations

Trade Name	*Supplier*	*Chemical Nature*
Aerosol-OT	American Cyanamid	Na salt of dioctyl sulfosuccinate.
AM-1100	Armour & Co.	decyl amine hydrochloride.
Tween 60	Atlas Powder	Sorbitan mono stearate polyoxyalkalene derivative.
Tergitol 7	Carbon and Carbide	Na secondary alkyl sulfate.
Triton W-30	Rohm & Haas Co.	Na aryl alkyl ether sulfate.
Triton 720	Rohm & Haas Co.	Na aryl alkyl poly ether sulfonate.
Triton 770	Rohm & Haas Co.	Na aryl alkyl ether sulfate.
Triton N-100	Rohm & Haas Co.	Aryl alkyl polyether alcohol.
Experimental		
Preparation A	Rohm & Haas Co.	Homologous aryl alkyl polyether alcohols.
Preparation B	Rohm & Haas Co.	
Preparation C	Rohm & Haas Co.	
Preparation D	Rohm & Haas Co.	
Preparation E	Rohm & Haas Co.	
Preparation F	Rohm & Haas Co.	
Preparation G	Rohm & Haas Co.	
Experimental		
Preparation H	Rohm & Haas Co.	Na isophorone sulfonates. U. S. Patent 2,301,561.
Preparation I	Rohm & Haas Co.	
Preparation J	Rohm & Haas Co.	

SANDOZ PRESENTS *the color achievement of the month*

Bassinet Blue BY CHATHAM

And Chatham Manufacturing Company, makers of the famous Chatham Baby Blanket, employs a wide range of other colors for its *complete* line of blankets.

"Chatham Makes Good Blankets" is becoming a buy-word for American women, and Sandoz is proud to be among Chatham suppliers, furnishing dyes that Chatham can depend upon for constant quality—efficiency in handling, fastness in service.

Among recent Sandoz developments is Brilliant Alizarine Milling Blue 2RL, a new acid dyeing blue producing bright royal blue tones that are fast to light, milling, washing, perspiration and salt water. Like its well known predecessor, Brilliant Alizarine Milling Blue BL, it obtains high fastness properties without chrome. It is the ideal color for "Baby Blues" for blankets, sweater and bathing suit work—as well as for more brilliant effects in men's and ladies' wear.

For acid, chrome or direct dyes... or auxiliary chemicals... for both natural and synthetic fibres... be guided by the successful "color achievements" you have been seeing in these Sandoz advertisements. Sandoz application laboratories are located in New York, Boston, Philadelphia, Los Angeles, Charlotte, Toronto, where stocks in wide range are carried. Other branches in Chicago, Paterson and Providence.

SANDOZ CHEMICAL WORKS, INC., 61 VAN DAM STREET, NEW YORK 13, N.Y.

SANDOZ *thinks ahead with textiles*

SANDOZ

G-4 gives you ...

MORE DURABLE MILDEW-PROOFING

The durability of Givaudan's G-4* during processing and in use assures your fabric full measure of protection from mildew and rot. G-4 can readily be applied to your fabrics, with no modification of finishing procedures. Effective in small concentrations, low in cost, and easy to apply, G-4 is extremely economical as a mildew-proofing agent.

G-4 imparts fungicidal and antiseptic properties to fabrics, and leaves them strong and pliant. It does not alter the "hand" of the goods, and imparts only negligible color and odor.

Improve your textile products with *durable* mildew-proofing. Write for full information on Givaudan's G-4 today.

**Dihydroxy Dichloro Diphenyl Methane*

"BUY WISELY—BUY GIVAUDAN"

Givaudan-Delawanna INC.

Industrial Products Division

330 West 42nd Street, New York 18, N. Y.

A COMPLETE LINE OF

DYESTUFFS

for all branches of

TEXTILE DYEING AND PRINTING—

PAPER AND LEATHER

★

Specializing in fast colors

NOVA CHEMICAL CORPORATION

147-153 Waverly Place New York 14, N. Y.

WAREHOUSES IN NEW YORK and CHARLOTTE, N. C.

QUALITY RICHMOND PRODUCTS

Less Handling with

AFTER CHLOR

Eliminates 3 to 5 Handlings

Bleach with Hypochlorite Rinse and Use

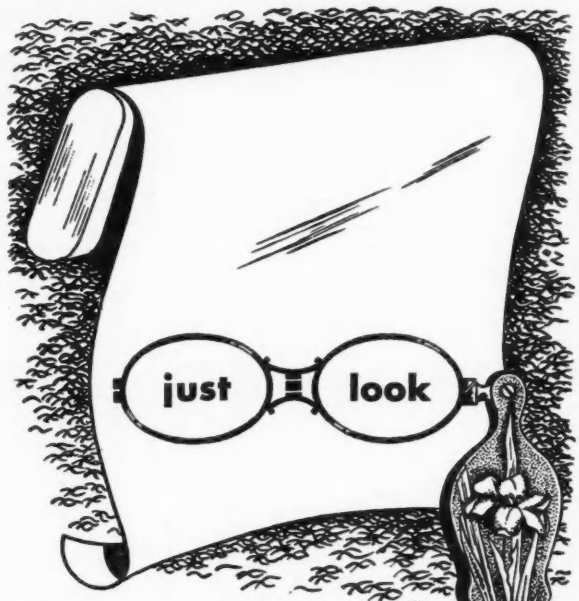
AFTER CHLOR

THAT'S ALL

Write for FREE Sample

RICHMOND OIL, SOAP & CHEMICAL CO., Inc.

1041-43 FRANKFORD AVE., PHILADELPHIA [illegible], PA.



how white!

Bleached as white as driven snow. Expect these superior, dazzling whites when you use Star Silicate to stabilize your peroxide bleach. With Star you're four ways surer:

1
Star is brilliantly clear; no floc to speed up peroxide decomposition.

2
Star is stable to dilution and heat so that it does not "break" to cause decomposition or deposits.

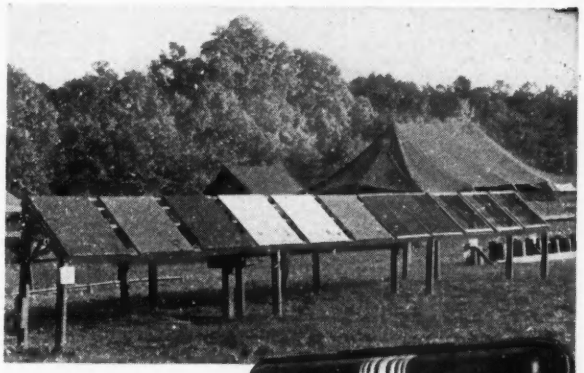
3
Star has reserve alkali that extends the working life of the bleach solution.

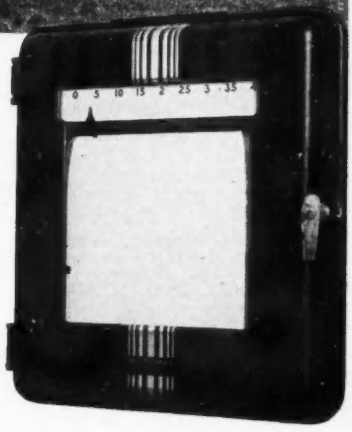
4
Star is especially purified to remove harmful iron and titanium found in ordinary silicates.

Star's long record of successful use covers all fibers — cotton, wool, silk, rayon mixtures, and both kier and continuous bleaching. See for yourself how Star improves bleaching results. We'll be happy to cooperate with samples and advice.

PHILADELPHIA QUARTZ COMPANY
Dept. A, 127 S. Third St., Phila. 6, Pa.

star **SILICATE OF SODA**





The problem of weather damage to Army tents is being studied in this area at Camp Lee, Va. Here, among rows of tents, are the open racks of fabrics and thread and the instruments which the Smithsonian Institution and Army use in their research. Picture at right shows a Micromax Recorder used in this research.

Micromax Saves Observer's Time By Recording Solar Radiation

Smithsonian Institution scientists working at Camp Lee are saving an appreciable number of man-hours per week by using Micromax Recorders to collect data on solar radiation. One of these instruments is connected to an Eppley Pyrheliometer and gives a clear, accurate, wide-chart record of the total solar radiation which falls onto the Eppley instrument in the tent-fabric research area, shown above. This Micromax is calibrated in gram calories per minute per centimeter square.

Another Micromax Recorder, not shown here, is a 16-point instrument recording temperatures of textile fabrics beneath various glass filters. It thus shows the temperature effect of screening out various wave-lengths of radiation.

These two Recorders eliminate the need for measuring and plotting radiation by hand several hundred times a day. In fact, the time required for a dozen of these measurements and plottings is probably ample to care for the Recorders for a week or more.

Standard Instruments

These Micromax Recorders are entirely standard, sturdy, dependable instruments of the kind widely used for recording industrial temperatures and many other conditions measurable by null-electrical means. We will be glad to send further information on request.

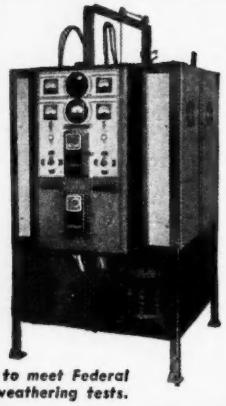
LEEDS & NORTHRUP COMPANY, 4965 STENTON AVE., PHILA., PA.
LEEDS & NORTHRUP
MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES
Jrl. Ad N-71(1a)

WEATHERING TEST FOR TEXTILES

Weathering effects of sunlight, rain, heavy dew and thermal shock reproduced in the laboratory at an accelerated rate that reduces years of actual weathering to a few days of testing in the —

ATLAS TWIN-ARC WEATHER-OMETER

The Twin-Arc Weather-Ometer has full automatic control of light and water periods. The Atlas Cycle Timer unit can be set to reproduce any combination of weathering conditions. A direct reading thermal regulator, automatic shut-off switch and a running time meter is included on the control panel. After setting exposure cycle on the control panel the Weather-Ometer is safe to be left in continuous operation over night without attention except to replace carbons once in 24 hours.



The Atlas Weather-Ometer is required to meet Federal Specifications demanding accelerated weathering tests.

ATLAS ELECTRIC DEVICES COMPANY
361 W. Superior Street, Chicago 10, Illinois

Originators and sole manufacturers for over a quarter of a century. . . Weather-Ometers, Launder-Ometers, Fade-Ometers are the accepted standard accelerated testing machines all over the world.

IDAHO *Potato Starch*

"THE FINEST MADE"

MAGIC VALLEY PROCESSING COMPANY
OF IDAHO

•

ST. ANTHONY STARCH COMPANY, INC.
OF IDAHO

•

MENAN STARCH COMPANY, INC.
OF IDAHO

DISTRIBUTED BY
AMERICAN KEY PRODUCTS, INC.
15 PARK ROW • NEW YORK 7, N. Y.

Effective Immediately

IMPORTANT CHANGES IN

CLOSING DATES

FOR

ADVERTISING COPY

1. All space reservations must be in our hands three weeks preceding date of issue.
2. Type-set advertisements three weeks preceding date of issue.
3. Complete black and white or color plates, two weeks preceding date of issue.
4. All inserts must be in our hands two weeks preceding date of issue.

•

AMERICAN DYESTUFF REPORTER
One Madison Avenue New York 10, N. Y.

"WAPACO" PRODUCTS
Serve the Textile Industry

WATSON-PARK CO. Wapaco leads BOSTON, MASS.

DYESTUFFS
CHEMICALS
TEXTILE SOAPS
TEXTILE OILS
STRIPPING COMPOUNDS

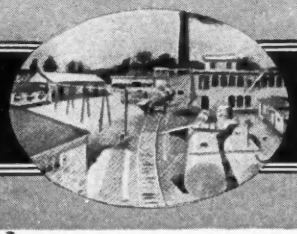
Liquid
HYDRALDEHYDE
THE NAME TO REMEMBER WHEN BUYING STRIPPING AGENTS

•

Outselling all others since its origin twenty years ago—it is *today* the woolen industry's *safe* stripper. Our constant efforts to eliminate free zinc in *liquid* HYDRALDEHYDE through modern manufacturing methods assure stronger fibres in reworked wool and piece goods.

Test *liquid* HYDRALDEHYDE against any other stripping agent offered—either powder or liquid— for a true comparison of the fibre's breaking strength.

•



Factory
LOWELL JCT.
MASS.

WATSON-PARK COMPANY
261 FRANKLIN STREET · BOSTON, MASS.

QUALITY RICHMOND PRODUCTS

CUT DOWN DYEHOUSE
Headaches
USE
DYETEX

- Disperses Dyestuff
- Scours
- Used in Scrooping

DYETEX

Send for free sample and full information

RICHMOND OIL, SOAP & CHEMICAL CO., Inc.
1041-43 FRANKFORD AVE., PHILADELPHIA 25, PA.

RAPIDASE

for de-sizing cottons, rayons and mixed goods

•

Assures rapid, dependable de-sizing.

•

Our technical staff always at your service.

•

WALLERSTEIN COMPANY, INC.
180 MADISON AVENUE • NEW YORK 16

PENETRANTS • DETERGENTS • SOFTENERS • REPELLENTS • FINISHES

BURK-SCHIER

BURKART-SCHIER CHEMICAL CO., CHATTANOOGA, TENN.

• CLASSIFIED ADVERTISEMENTS •

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $7.50 per column inch or less per insertion.

CONFIDENTIAL EMPLOYMENT SERVICE—For Dyers, Chemists, Colorists, Managers, Superintendents and others seeking positions and for employers seeking men. Many positions paying attractive salaries, open for capable men. Charles P. Raymond Service, Inc., 294 Washington St., Boston, Mass. Over 45 years in business.

POSITION WANTED: Hosiery Dyer with several years experience on ladies' hose of Silk, Nylon, Rayon and Cotton. Available for employment on request. Either as Head Dyer or Assistant to Head Dyer. Write Box 198.

POSITION WANTED: Textile Chemist with 9 years general experience in all types of textile laboratory work and testing. Experience mostly on wool but some on all fibers including viscose rayon production experience. Desire laboratory, production, or technical sales. Age 35 years. Write Box 217.

WANTED: SALESMAN. Excellent opportunity for the right man with leading chemical manufacturer for New England territory. Must have selling experience and personal contacts and preferably chemical or textile mill background. Write complete details to Box 218.

WANTED: Young graduate Textile Chemist for research on surgical quality cotton and gauze. Must be a textile school graduate or have textile experience. Excellent opportunity for the right man. Write Box 219.

WANTED: Assistant Ribbon Dyer by small shop in Metropolitan area. Practical man with experience in Acetate, Viscose, and cross dyeing. State age, experience and salary expected. Write Box 220.

POSITION WANTED: Dyer with many years experience on Rayon, Acetate & Wool mixtures, piece goods, graduate chemist able to handle a dye-house. Write Box 222.

PRODUCTION DYE CONTROL

A man educated in the chemistry of dyeing fabrics. Must have had practical experience in the operation and control of commercial dyeing, particularly in the dyeing of narrow fabrics. Must also be experienced in direct, developed and vat dyeing. Salary open. Write Box 223.

WANTED: Graduate Chemist for modern dyehouse in the Metropolitan Area. Must either be a Textile School Graduate or a Chemistry Major with Textile Chemistry experience. Excellent opportunity for the right man. Please state age and salary expected. Write Box 196.

WANTED: Textile Colorist for Modern Print Shop in the Metropolitan Area. Please state age, and salary expected. Write Box 197.

REPORTER

CLASSIFIEDS

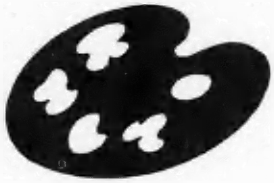
BRING RESULTS

DYESTUFFS

DIRECT - ACID - CHROME
FORMALDEHYDE - ACETATE

UNIFORMITY

With a background of many years of approval before the bar of public opinion.



PURITY OF COLOR

Custom made from best quality raw materials, producing products of high standing in the trade.

Stocks Carried by All Dyestuff Distributors in All Textile Centers

YOUNG ANILINE WORKS

OFFICE and FACTORY
2701-2733 Boston St., Baltimore, Md.

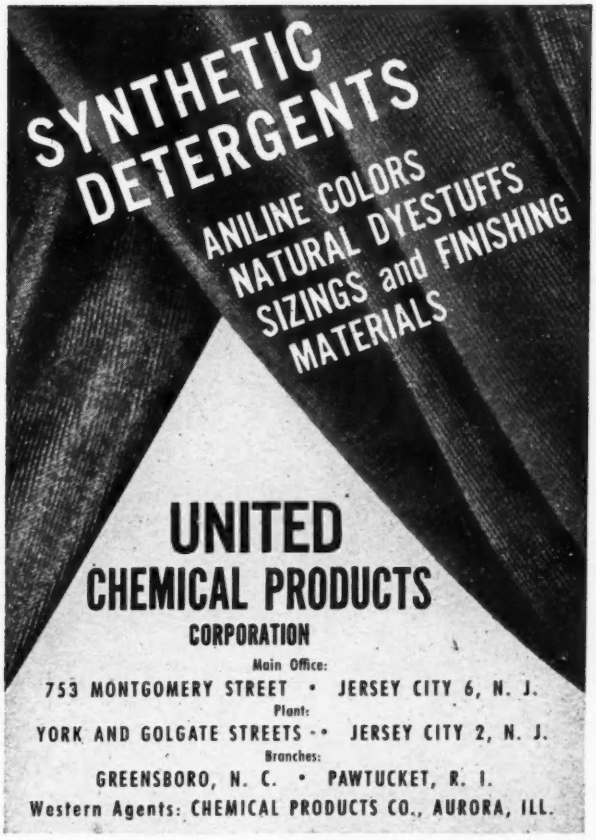
PATERSON OFFICE
50 E. 13th Street, Paterson, N. J.

Have you ordered a Binder for your Reporter copies?

Maroon leatherette, gold lettered, large enough to hold twenty-six issues, only $3.00 post-paid.

Please send check with order to:

AMERICAN DYESTUFF REPORTER
ONE MADISON AVENUE
New York 10, N. Y.



10 PRODUCTS of Proven Dependability

WHICH SHOULD WARRANT ★ YOUR ATTENTION ★

***AQUAROL :** A water repellent for processing woolen, cotton and rayon fabrics, also produces excellent results in splashproofing or finishing all types of hosiery.

***PARAMINE S :** A cation active softener for processing cotton and rayon cloth to obtain a soft, smooth, pleasing finish.

***ALGEPON S :** An assistant in dyeing vat colors to prevent premature oxidation of the reduced bath and eliminate uneven dyeings.

***ALGEPON V A :** Assistant for stripping vat colors—complete reduction of color in stripping bath providing lighter bottom for redyeing.

***PARAPON S A :** A highly efficient leveler and softener for dyeing and finishing all types of yarn, cloth and hosiery to produce a uniform dyeing and a soft full hand.

***ARIPEL F S :** Finish and gas inhibitor for processing dyed acetate rayon—produces a soft full feeling finish and prevents gas fading of the color.

***LANITOL F :** A synthetic detergent possessing exceptional scouring and washing properties for processing wool, cotton, rayon or nylon.

***CULOFIX :** Used as an after treatment in last rinse to prevent bleeding of direct dyed cotton or rayon in water.

***DIAZONOL A C :** For boiling out cotton cloth in pressure or open kiers to produce greater absorbency and cleaner material. Excellent for preboiling knitted cloth in preparation for chlorine bleach. Also used with good results for boiling out cotton or rayon cloth on the jig.

***TETRANOL 1638 :** A rapid wetting and penetrating agent. Active in acid, alkaline and salt solutions and not affected by hard water, may be used in all types of dyeing operations to insure positive penetration of color and a uniform and solid shade.

And a Complete Line of Oils, Chemicals, Softeners and Finishes For Wet Processing All Textile Fibres

*Reg. U.S. Pat. Off.

ARKANSAS CO. Inc.

Newark, New Jersey

ESTABLISHED OVER 40 YEARS

● INDEX TO ADVERTISERS ●

Althouse Chemical Co.
Amalgamated Chemical Corp.
American Aniline Products, Inc. XVII
American Cyanamid Co. (Ind. Chem. Div.) ..... Second Cover
American Cyanamid Co. (Textile Resin Dept.)
American Dyewood Company
American Key Products, Inc. XXVIII
Arkansas Company, Inc. XXXII
Arnold Hoffman & Co., Inc.
Atlantic Chemical Co.
Atlas Electric Devices Co. XXVIII

Becco Sales Corp.
Bick & Co., Inc.
Blickman Co., S.
Burkart-Schier Chemical Co. XXX
Butterworth Sons Co., H. W.

Calco Chemical Division American Cyanamid Co.
Calgon, Inc.
Campbell & Co., Inc., John
Carbic Color & Chemical Co., Inc. XXII
Carbide & Carbon Chemicals Corp. ..... Third Cover
Ciba Company, Inc. III
Colgate-Palmolive-Peet Co.
Commonwealth Color & Chemical Co.

De Paul Chemical Co., Inc.
Drew & Co., E. F.
Du Pont de Nemours & Co., E. I.
Dyestuff Division

Emery Industries, Inc.

Fallek Products Co., Inc.
Fancourt & Co., W. F.

Geigy Company, Inc. ..... Front Cover
General Chemical Company XIX
General Dyestuff Corp. IV
Girdler Corp., The XXVI
Givaudan-Delawanna, Inc.

Grinnell Co., Inc. X
Hardesty Co., W. C.
Hart Products Corp.
Heyden Chemical Corp.
Hooker Electrochemical Co. VIII

Interchemical Corp., Textile Colors Div.
International Salt Co., Inc.

Kali Manufacturing Co.
Kelco Co.

Laurel Soap Mfg. Co., Inc.
Leatex Chemicel Co.
Leeds & Northrup Co. XXVII

Maher Color & Chemical Co.
Marathon Corp. VII
Mathieson Alkali Works, Inc. VI
Maywood Chemical Works XI
Monsanto Chemical Co.
Myles Salt Co., Ltd.

National Aniline Division, Allied Chemical & Dye Corp. XV
National Carbon Co., Inc.
National Starch Products, Inc.
Nopco Chemical Co.
Nova Chem. Corp. XXVI
Nuodex Products Co., Inc.
Nyanza Color & Chemical Co.

Onyx Oil & Chemical Co. XVIII
Oronite Chemical Co.

Pabst Sales Company
Perkins & Sons, Inc., B. F.
Philadelphia Quartz Co. XXVII
Procter & Gamble
Proctor & Schwartz, Inc.

Refined Products Corp. IX
Richmond Oil, Soap & Chemical Co., Inc. ..... XXVI, XXIX
Riggs & Lombard, Inc.
Rohm & Haas Company XXXIV
Royce Chemical Co. ..... Back Cover
Rumford Chemical Works

Sandoz Chemical Works XXV
Scholler Bros., Inc.
Sharples Chemicals, Inc.
Smith, Drum & Co.
Socony-Vacuum Oil Co., Inc. V
Solvay Sales Corp. XX
Sonneborn Sons, Inc., L.
Standard Brands, Inc.
Standard Chemical Products, Inc.
Standard Oil Co. of N. J. XXIV
Stein Hall & Co., Inc.

Tennessee Eastman Corp. XIII
Titan Chemical Products, Inc.

Ultra Chemical Works, Inc. XXI
Union Carbide & Carbon Corp. ..... Third Cover
United Chemical Prod. Corp. XXXI

Vanderbilt Co., Inc., R. T. XIV
Van Vlaanderen Machine Co.
Virginia Smelting Co.

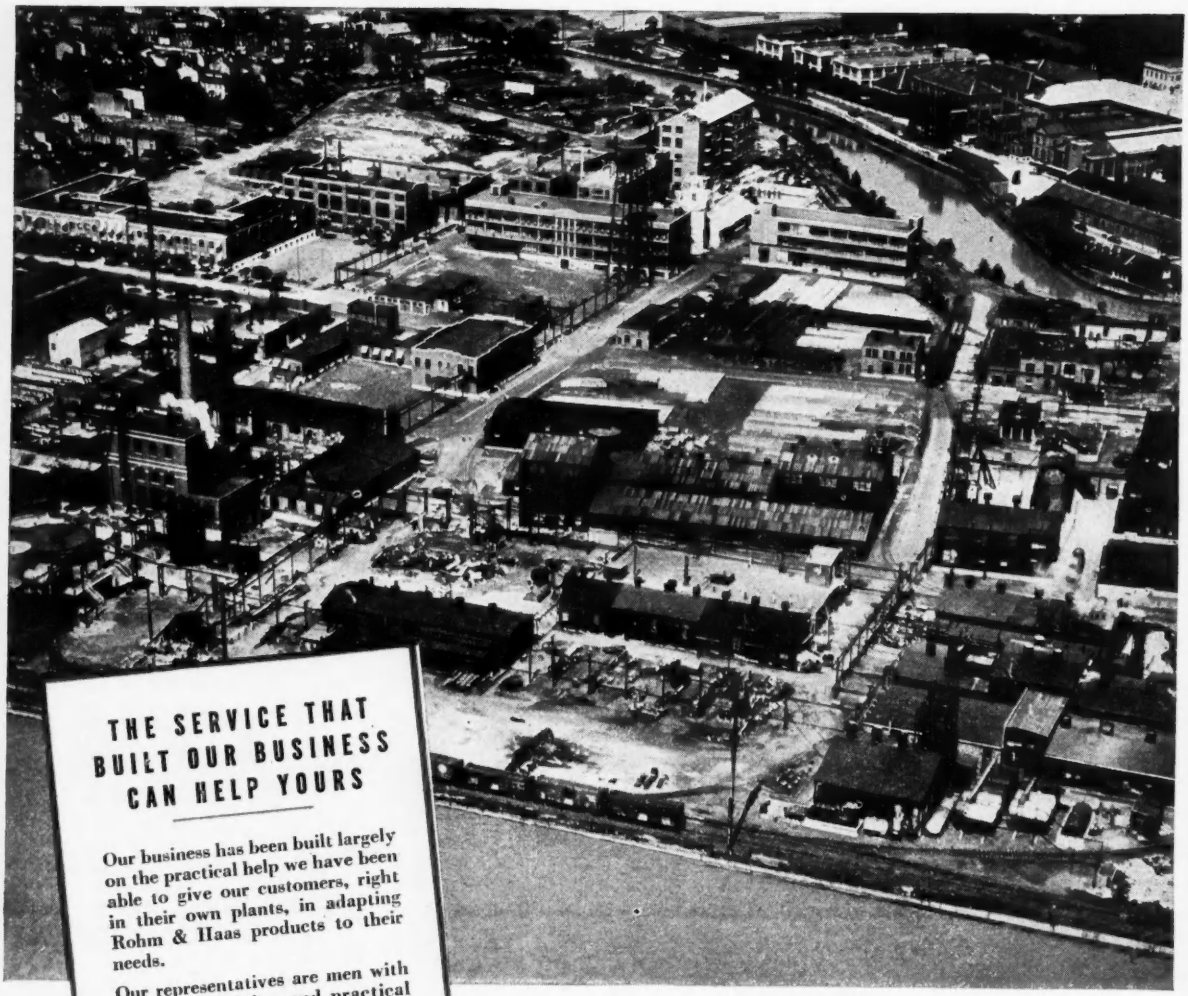
Wallerstein Co., Inc. XXIX
Warwick Chemical Co.
Watson-Park Company XXIX
Wolf & Co., Jacques XII
Young Aniline Works XXXI
Young Co., J. S.

Zinsser & Co., Inc.

XVII Cover
XXVIII XXXII
XXVIII
XXX
XXII Cover III
Cover XIX
IV XXVI
X
VIII
XXVII
VII VI XI
XV
XXVI
XVIII
XXVII
IX XXIX
XXXIV Cover
XXV
V XX
XXIV
XIII
XXI Cover XXXI
XIV
XXIX
XXIX XII
XXXI

Where TRITONS and RHONITES are made...

along with other reliable Textile Chemicals



THE SERVICE THAT BUILT OUR BUSINESS CAN HELP YOURS

Our business has been built largely on the practical help we have been able to give our customers, right in their own plants, in adapting Rohm & Haas products to their needs.

Our representatives are men with technical training and practical experience in the use of industrial chemicals. Call in a member of our textile chemicals department when you need assistance in choosing or using . . .

Chemicals For Fine Textiles

TRITONS... Surface active agents for increasing textile wet processing efficiency. A TRITON for every purpose.

RHONITES... Urea formaldehyde condensates—the first American textile resins offered commercially for crease-resistant fabrics.

TRITON *and* RHONITE *are trade-marks, Reg. U. S. Pat. Off.*

Represented in Canada by Rohm & Haas Company of Canada, Ltd., Toronto; and in South America by Cia. Rohm y Haas, S. R. L., Carlos Pellegrini 331, Buenos Aires, Argentina, and agents in principal South American cities.

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Manufacturers of Chemicals including Plastics • Synthetic Insecticides • Fungicides • Enzymes • Detergents
Germicides • Chemicals for the Leather, Textile, Ceramic, Rubber, Paper, Petroleum and other Industries

TERGITOL WETTING AGENTS

TRADE-MARK

Are stable... efficient... economical

The three "Tergitol" wetting agents are powerful surface-tension depressants and have a wide variety of uses. Water solutions containing as much as 20 per cent dissolved materials such as acids, bases, salts or dyestuffs, can be made to spread more evenly or penetrate faster using a "Tergitol" wetting agent. As little as 0.1 per cent of a "Tergitol" compound in an aqueous solution will produce:

Rapid and Uniform Penetration of porous materials such as textile fibers, paper, and leather.

Quick Wetting of pigments, dyestuffs, powders, clay, cement, dust, and other dry articles.

Effective Surface Spreading on glass, metal, wood, plastics, or foliage surfaces which ordinarily resist wetting.

Emulsification of many oils, resins, and chlorinated or water-insoluble solvents.

De-emulsification of many water-oil and solvent-water emulsions.

Additional technical information is available. Ask our nearest office for Form 5900.

"Tergitol" is a registered trade-mark of Carbide and Carbon Chemicals Corporation.

"TERGITOL" 7

. . . most efficient for dilute aqueous solutions containing less than one per cent dissolved solids. Under such conditions it is one of the most powerful commercial wetting agents.

"TERGITOL" 4

. . . a superior wetting agent for more concentrated solutions, containing from one to five per cent dissolved materials. It is stable, even under the conditions encountered in wool carbonizing and cotton stock bleaching.

"TERGITOL" 08

. . . most effective for highly concentrated solutions of acids, bases, salts, or dyestuffs. Because of its solubility, chemical stability, and penetrative action in these solutions, it is a remarkable assistant wherever such conditions are met.

CARBIDE AND CARBON CHEMICALS CORPORATION

Unit of Union Carbide and Carbon Corporation

UCC

30 East 42nd Street, New York 17, N. Y.

Offices in Principal Cities

DO NOT CIRCULATE
GREENVILLE PUBLIC LIBRARY

Sales Appeal

with Drytex* NATURAL FINISH WATER REPELLENT

This new wax-emulsion type water-repellent has many advantages. MORE WAX . . . no other water repellent equals Drytex for wax content. EASIER TO MAKE UP . . . unlike pastes and heavier liquids, Drytex pours like milk. IT ABSOLUTELY DOES NOT FOAM . . . you know what that means to you!

Drytex is ideal for the textile trio—wool, cotton, and rayon. Correctly applied, it has a water repellent rating by AATCC Standard Test of 100!

Stable in storage, stable in the bath, Drytex offers many economies—while keeping the natural draping qualities of fabrics, adding full water repellency. Try a sample. Compare. You'll see Drytex is best by test.

ROYCE CHEMICAL CO.

*Reg. Trade Mark

ROYCE CHEMICAL CO.

CARLTON HILL, NEW JERSEY

MANUFACTURERS OF NEOZYME* • PAROLITE* • DISCOLITE* VELVORAY* • FABRITEX* • GUMOLITE* • CASTROLITE* VATROLITE* • ZIPOLITE*

ST 2724A

ul
ENT
AX...
MAKE
milk. IT
to you!
plied, it
of 100!
rs many
fabrics,
ompare.
2724A